AMATEUR MOVIE MAKING

USED AS A
SUPPLEMENTARY TEXT
IN NEW YORK INSTITUTE
OF PHOTOGRAPHY

C. D. Hudson

Funded by a donation from
Jeff Joseph

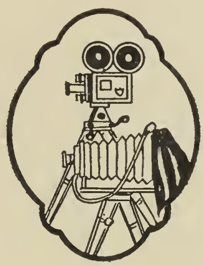
These stills from a recent UFA production show what may be done in one of the most fascinating phases of amateur cinematography, animation.

AMATEUR MOVIE MAKING

BY

HERBERT C. McKAY, A.R.P.S.

Director of the New York Institute of Photography
Author of the Handbook of M. P. Photography, etc.



NEW YORK
FALK PUBLISHING COMPANY, INC.
10 WEST 33RD STREET

THE
NEW YORK INSTITUTE
OF
PHOTOGRAPHY

Eighteen years of unremitting service have given to the New York Institute of Photography a most enviable reputation. To-day it is recognized as the foremost school of photography in the world. It offers unequalled facilities to those who come to its studios for instruction and extends its educational advantages to students everywhere through its practical home study courses.

Because the same high standards, the same thoroughness and the same individual method of instruction which characterize its resident classes have been applied to the teaching of photography and cinematography by the correspondence plan, the home study courses of the Institute have achieved an outstanding success.

The New York Institute of Photography through affiliation with the Falk Publishing Company and with the Institute Standard Camera Company, is without doubt, the greatest photographic organization the world has ever known. It is obvious that such unusual success is founded, must be founded, upon unquestionable integrity and unfailing service.

PRINTED IN THE UNITED STATES OF AMERICA
BY STRATFORD PRESS, INC.

ACKNOWLEDGEMENT

It gives the writer great pleasure to acknowledge the aid given so freely in the preparation of this book by many individuals and firms. The preparation of the book itself, and the arrangement of the material was accomplished with the help of the officials of the Amateur Cinema League, Col. Roy W. Winton, Walter D. Kerst, J. B. Carrigan and Arthur L. Gale. Mr. Stephen L. Sturz of Willoughby's, Incorporated, and the firm of Herbert and Huesgen also gave valuable information in this first step.

The manufacturers gave freely of their time during the writing of the first part of the book, Charles Bass, Bell & Howell, Mr. H. A. DeVry, The Eastman Kodak Company, and Mr. A. F. Victor doing everything possible to further the work.

The chapter on lenses and optical accessories was made possible by the information supplied by the C. P. Goerz American Optical Company, Hugo Meyer and Company, Wollensak Optical Company and Carl Zeiss, Incorporated.

The experimental chapter is due to the cooperation of Mr. W. A. Shoemaker, editor of the Ciné Kodak News and of Mr. E. M. Tobias of the DuPont-Pathe Film Manufacturing Corporation. The data on tinting and toning was supplied by the Eastman Kodak Company.

Data on arc illumination was supplied by the M. J. Wohl Company and by Mr. Leonard Westphalen. Mr. Burleigh Brooks assisted in securing filter data, Mr. Ralph R. Eno helped to prepare the title material, Miss Vera L. Standing supplied the scenarios, while the material regarding Filmslides was given by E. Leitz, Incorporated.

Many technical points, concerned with exposure, development, printing, camera speed and projection would have been impossible without the help of Mr. Joseph M. Bing of the Drem Products Corporation, and Mr. R. P. Stinemann.

And last but not least, great credit is due the officials of the New York Institute of Photography, who gave unfailing assistance and who placed the entire facilities of their splendid studios at the disposal of the writer during the preparation of this work.

HERBERT C. MCKAY.

FOREWORD

In recommending to the amateur cinematic world this book on amateur movie making, I am not unaware of the excellent volumes already given to the public that discuss the world's newest avocation from a variety of viewpoints. Mr. McKay has here, it seems to me, achieved a unity and a fulness that are worthy of especial interest and commendation.

This volume gives promise of a basic literature on personal motion picture making. Such books as this will appear, it is to be hoped, in increasing numbers. They will appear because personal motion picture making has brought cinematography into the lives of the people. We have known, for nearly thirty years, that a new force has come into the world and we have appraised its influence as we appraise the effect of forces that are external to the great mass of individual men and women. This kind of appraisal, for example, was made when railroad transportation entered the life of the world. Rapid transit was with us. But a new evaluation was called forth when rapid transit became personalized with the advent of the automobile.

Thus with the motion picture. Until it was liberated for individual application we looked upon it as something external, in the last analysis. Now it is not only ours as a race but it is the individual possession of each of us. In this last phase, cinematography becomes an affair of enormous significance in the history of the world because the world has achieved a new medium of individual and personal expression. Whatever a man may have to say, henceforward, he has another voice with which to say it.

All motion picture amateurs can thank Mr. McKay for this comprehensive statement concerning personal cinematography. He has written it from their own point of view. He has done a practical thing, in that he has given them information that is essential to their activities; he has done a philosophic thing in that he has made an evaluation of

cinematography as a world factor and as an artistic medium.

Personalized motion pictures are invading many new fields. Industry has used professionally made movies for a number of years for screen showings in theatres and to fairly large groups; now, industry can carry its story to individuals in their homes and their offices by means of amateur projectors now, a thousand members of a great industrial concern can record their personal contributions in film by means of amateur cameras. Educators can make their own films and can project them without limitation. Scientists can make individual applications of motion picture photography. Personnel management and social direction can obtain accurate group and case histories through this new recording and exhibiting medium.

There are probably close to one hundred and twenty-five thousand motion picture amateurs in the world today. The Amateur Cinema League has members and readers of its magazines in thirty-three foreign countries. More than thirty local groups in the United States and abroad are intensifying their cinematic pleasure by united action. Amateurs will multiply by thousands. The Amateur Cinema League, as the organization of these thousands, feels an obligation to encourage every forward step in cinematography. Such a forward step is the publication of this volume.

Those of us in the Amateur Cinema League welcome every intelligent and reasoned statement concerning our activity. We were banded together in order that we might cooperatively find the farther reaches of this new human occupation. We appreciate motion pictures because we make them. We know their potency.

An eighth art is at hand. A new medium of human expression is here. It must evolve for itself the discipline and order, the restraint and selectivity, the unity and centrality that have been essential to the other arts. This can come only from an understanding study of its fundamentals and from a clear conception of its interrelation with the rest of life. The beginning of that interrelation and integration is foreshadowed in the pages that follow. Those pages shed light on the present and throw a prophetic gleam into the future.

ROY W. WINTON,
Managing Director,
Amateur Cinema League.

CONTENTS

CHAPTER PAGE

Introduction 1

Part One

THE AMATEUR CAMERAMAN

I. The Fascination of Amateur Movies . 7
II. Motion Photography and the Motion Camera 14
III. Shooting the Amateur Film . . . 39
IV. Exterior Lighting 80
V. Interior Lighting 94
VI. Lenses and Optical Accessories . . 128
VII. The Motion Picture Title 160
VIII. Trick Work with the Miniature Camera 190
IX. Editing the Home Film 213
X. Home Projection 235
XI. For the Experimenter 268

Part Two

THE AMATEUR PRODUCER

XII. The Art of Cinematography . . . 303
XIII. Amateur Films 310
XIV. Record Films 316
XV. Analytic and Instruction Record Films 326
XVI. Nature Study and Scientific Films . 335
XVII. The Amateur Production Company . 348
XVIII. The Scenario 356
XIX. Preparing to Shoot the Amateur Film 372
XX. Directing the Home Film 382
XXI. The Production and Use of Filmslides 401

Part Three

APPENDIX

I. Formulae 408
II. Glossary 433

INTRODUCTION

Pictorial representation is so essential in human life that we realize its existence only through its absence. Only when deprived of our artistic expression do we realize the tremendous part played by art in our everyday, humdrum, practical lives. And, by the way, by art is meant not that jargon of empty phrases, not that inane and insane daubing which is known as the modern school, but those concrete expressions of intangible emotions to which the soul of the common man—and woman—responds.

The typical, the normal art of modern mankind is photographic. In keeping with our age the drudgery has been removed from art. The lens gives us draughtsmanship, the sun itself gives us our palette, and we are freed to give expression to such divine sparks as we may have within us. True, all photographs are not art, nor is all painting. A beautifully made commercial photograph, however, is more artistic than a huge signboard screaming, "They Satisfy" in letters of blazing reds, yellows, greens and other colors beloved of primitive peoples.

We have come to accept the photograph as commonplace, but so great is the burden that it has taken upon itself, that to remove from the world to-day all photographs, all photographic equipment and processes would be to wreck our civilization. Our very printing presses would be silenced for our finest typographical products are produced by photographic means.

Of all photographic processes, no single one has the importance of the motion picture. You of course think instantly of the vast "fillum" producing companies. That is, of course, a tremendous industry, but it is after all only a manufacturing industry to which the motion picture has been adapted. The true value of the motion picture is potential rather than actual, and this potentiality may be materialized by the amateur in the years immediately before us!

First of all we must learn that the motion picture is primarily a photographic process, and has no inherent

relation to any form of dramatic art. We happen to have developed that phase of the motion picture disproportionately. The motion picture is, of itself, a new art, with little in common with either draughting or drama. It is sufficient unto itself.

Moreover, the motion picture readily lends itself to purely utilitarian purposes. In fact one of the greatest attractions of the animated photograph is the almost unlimited versatility of the process. There is not a sport, not a business, not a profession, neither vocation nor avocation to which the motion picture cannot be profitably adapted. This fact has been recognized to some slight degree, but, not until the amateur has become so familiar with the work that its attraction becomes one of utility rather than novelty, will the true value of the motion picture be disclosed to the world. Because this great responsibility rests with the amateurs of to-day and to-morrow, the writer has ventured to write seriously of a process which has long enough been regarded as a novel toy for adults.

Most of you who read this will have a fair idea of the development of the dramatic motion picture in this country, but the short history of the amateur motion picture is not so familiar. There have been amateurs working with motion pictures since the discovery of the process and the invention of the apparatus by C. Francis Jenkins, in the late Nineties. However, the first real impetus was not given the amateur movement until the introduction of the safety film, in which Mr. A. F. Victor played an important part. Mr. Victor has been associated with the development of the amateur work ever since that time.

Then came the popularity thought by many to mark the beginning of the amateur movement, which popularity was due directly to the introduction of the 16 millimeter film. Just why this is true is not known. The single item of expense cannot be held responsible, for most present day owners of miniature cameras could well afford to maintain a standard size outfit, nor was it the factor of safety, for we had safety film before the introduction of the miniature equipment. It could not have been the reversal process for the casual movie maker is not concerned with the process by which his films are made usable. It may be that the small size, light weight and motor drive gave these small instruments their first popularity. It is safe to say, how-

ever, that if the sixteen millimeter equipment could be wiped out to-day that there would not be any great diminution in the number of amateur cinematographers. To-day, size is a matter of preference. Many amateurs are using standard film for strictly private uses, while many industrial firms are making sixteen millimeter positive for commercial use.

December, 1922, marks the birth of amateur motion picture photography as a distinct field of amateur photography. That month the photographic journal, Photo Era, inaugurated the first regular amateur motion picture department to be published in any technical magazine. This department was started under the direction of the writer of this volume and has continued until the present time. At its debut, other photographic publishers openly ridiculed the idea, damning the amateur motion picture as a passing fad, but at the present time all of the major photographic publications of this country have their amateur cine departments, two periodicals have appeared which are devoted exclusively to this work, and one of the greatest organizations ever formed for the advancement of a pastime or of an art has come into being as a direct result of the amateur cinema. I refer to the Amateur Cinema League.

Not only is this true, but the amateur has already rendered the greatest possible service to the cause of the motion picture. Through years of technical development, the esthetic side of motion photography was yet unborn. The only esthetic claims made were the doubtful ones made in the name of the motion picture drama, which is after all, but a substitute for the spoken drama. Only during the present year has the esthetic of the motion picture been formulated. For this we are indebted to no little degree to Colonel Roy W. Winton, Managing Director of the Amateur Cinema League who has said that the motion picture is "unlimited motion dramatically applied!"

However, the development of any art is due to the efforts of a small band of crusaders. In modern times such a band find their efforts hopeless without the assistance of commercialism, which in turn comes into being only by reason of the demand of the man-in-the-street whose appreciation of higher art is so often unconscious if existent at all. Therefore, to the great army of men and women who have found delight in making films of Junior, to the numberless

boys and girls who want to make movie records of delightful vacations we are indebted for the present high place occupied by the amateur motion picture, and to them this book is addressed, in the hope that it may make possible films of Junior which will reveal his face in a more natural manner, and films of the vacation in which something more than a dim, scampering form is visible.

Herbert C. McKay

Part One

THE AMATEUR CAMERAMAN

CHAPTER ONE

THE FASCINATION OF MAKING YOUR OWN MOVIES

There is a fascination in making your own moving pictures which can be found in no other sport or pastime. The mere fact that we can capture such an elusive thing as a passing motion, record it and keep it for future reference, gives this work an irresistible appeal. For this reason the popularity of amateur motion picture work is growing rapidly and promises to rival the popularity of the radio in the near future. This is no more than logical, as the eye-path to the brain is far more highly developed than is the ear-path.

We all have a penchant for the mysterious. Most beloved of our childhood's books was the Arabian Night's Entertainments and in later years many of us have found deep pleasure in reading the literal translation of the Thousand and One Nights. Even in this materialistic age we find that the lure of magic is irresistible. But what conjuring of the seers of ancient times could compare with magic of modern science? There is nothing in the old Black Art which can compare with the marvels of modern magic—only familiarity has blinded us to the wonder, the beauty and the romance of this modern magic. That which was the masterpiece of the feared magician is now duplicated in our own homes and to us it is more or less commonplace.

The fascination of the motion picture, and of radio, is that fascination which we, blasé as we may wish to think ourselves, find in the mysterious, the unknown! Nor is this attitude to be condemned, for the motion picture has annihilated time, space and size. We can never fully appreciate that process which enables us to sit at ease in our own homes and see before us the actual battles fought by armies on the other side of the earth. We can never fully appreci-

ate the modern magic which enables us to see again upon the screen the pleasures which we enjoyed in past years. Mohamet's mountain was an insignificant incident, for by substituting an electric switch for a magician's wand we bring to our own drawing room, any portion of the earth we may desire.

One recalls Wells' fanciful story of the "Accellerator" which is regarded as the height of imagination, yet we all experience the same sensation when we see the slow motion pictures, and we inject the "Accellerator" into plants when we see the time condensation film which shows us a plant growing from seed to full bloom in a minute or two.

Every child has envied Alice and the magic potions which made her just the right size to enjoy her environment, but upon our magic screen we see the battle raging between disease germs and the blood cells of our own bodies and then we see an eclipse of the sun upon the same screen. Thus companionably associated we see objects which are measured only in fractional thousandths of an inch and those whose dimensions necessitate the consideration of thousands upon thousands of miles. Vivid indeed must be the imagination which can describe to us any scene or event which cannot be shown through the medium of our motion picture films.

The human race is devoted to pictorial representation. Whether this be crude or perfect, the demand for it is felt in every quarter of our globe. Yet, this pictorial art is conventional and artificial. Even the still photograph is more symbolic than exact. We have separated the life of our world into two great classes, animate and inanimate. We are creatures of motion, only in death do we relinquish movement. Motion is an integral part of our life, and any representation of life which is without motion is artificial and inadequate. A carefully posed photograph appears unnatural. This is the true reason that so many portraits are unnatural. It is difficult for the best portrait artist to pose his subject in a manner that has a natural appearance; on the other hand, when we try to snap objects in motion the result is even worse. Perhaps there is no more graceful motion known to mankind than that of a carefully trained

esthetic dancer, yet an instantaneous exposure gives us a photograph which is at best grotesque. The motion photograph shows us our friends and relatives as we know them in real life. It changes the grotesque posture of the dancer to beautiful, poetic motion. Is it any wonder then, that the moving picture has already become an indispensable part of modern life, in the home as well as elsewhere?

Even with these advantages, the motion picture could not have become truly popular without its present day simplification. Due to the research of the manufacturers, we have now available apparatus and supplies which enable us to make our own motion films by merely sighting the camera and pressing the release. No small part of this development has been due to the perfection of the reversal process which changes the photographic negative to a positive, rendering the process more simple and less expensive than would otherwise be the case.

The cost of the process, even now, is by far the greatest objection to its use, but careful consideration shows this to be an academic objection only. We purchase a one hundred foot roll of film which has space for four thousand separate exposures. This we purchase for less than four dollars, or less than one-tenth of one cent per picture. If we also pay for developing at the same time we pay fifty percent more, or about three-twentieths of a cent per picture, and by means of a device now on the market we can actually make paper prints of any one of these four thousand tiny negatives, in a size quite large enough for mounting in the usual album. So negative for negative the amateur motion picture is the least expensive photographic process we have.

It may be objected that the comparison is unfair. Then, to make the fairest possible comparison, we will consider the actual enjoyment afforded by both processes, in terms of dollars and cents.

The sizes of photographs made by amateurs range from the vest pocket size to post card size. A fair average is the 3¼ x 4¼ size, or the quarter plate as it is known in England. Let us imagine ourselves looking through an album showing the vacation of last year as depicted in six dozen photographs. We will spend

approximately ten seconds looking at each photograph or twelve minutes to look at the entire lot. This is generous allowance of time, but to give every advantage to the still side of the question we shall add one-third and make it sixteen minutes for the seventy-two photographs.

Now let us tabulate the cost of these six dozen photographs.

6 dozen films @ 90c per dozen........	$5.40
Developing 12 rolls of film @ 15c......	1.80
Printing 72 positives @ 6c each......	4.32
Album for prints....................	1.50
Total	$13.02

The average cost, then, of ordinary snap-shots amounts to approximately thirteen dollars for sixteen minutes actual use. Of course this period of sixteen minutes is repeated over and over, but as this is true for both still and motion pictures we can disregard this point.

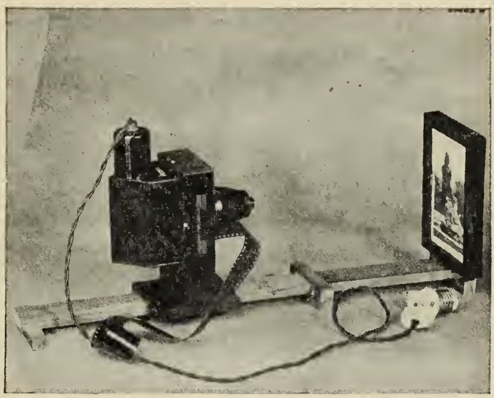
The owner of the motion picture camera will use twenty-four dollars worth of film in making a sufficient length to have a screen time of sixteen minutes. Of this about twelve minutes will be actual action, the remainder being titles. This means that he will have roughly thirty-six scenes. If he wants to do so he can easily secure two still enlargements from each scene, or seventy-two paper prints, and in addition he has a sixteen minute reel of motion film.

By doubling the cost the owner of the motion picture camera can secure the same period of enjoyment from his motion film that the still cameraman gets from his prints, and in addition the motion picture cameraman can have the same number of still pictures.

Thus we see that in reality the motion picture costs only twice as much as the still pictures, while giving both still and motion pictures. In actual practice the difference is far less, for we have to consider the still films lost through careless operation, a loss which is very rare in the case of motion pictures.

But after all, the question of expense is of minor importance. Who is there who would not prefer a four-minute action film to a hundred still photographs? The

amateur still photograph, as a record especially, is usually grotesque and acceptable to us only by virtue of being an accepted convention. We have seen the amateur still camera start as a toy, a novelty, used only for making snap-shots of people; and we have seen it advance until at the present time it is used as a tool by the most capable and serious of artists.



The Dremette Movie Enlarger. This little instrument makes it possible to secure enlargements up to post card size from single frames of either 16 m/m or standard motion picture film.

We cannot ignore the artistic possibilities of any form of pictorial representation. Note that the word "possibilities" is used. Too many of us are prone to think that any kind of picture is a work of art. True, art deals with reproductions, more or less true to nature, of familiar objects and scenes. But study will reveal the fact that in every true work of art, the actual subject of the work is incidental, it is symbolical. The true appeal of the work of art is to our emotions. Hence we may say that art is the expression in tangible form of human emotion.

Almost twenty-three hundred years ago Aristotle designated the arts as architecture, sculpture, painting, dancing, drama, poetry and music. These basic arts have remained unchanged through the centuries. Of course, drawing, etching and similar processes have been added to painting, and poetry now includes literature in general, but basically the world of art has until recently been divided among these seven arts. Now we have the eighth art,

the first art to be given to the world in twenty centuries and more, and the art which will eventually become the greatest of all—the motion picture.

We have been handicapped in pictorial artistic expression. We have been forced to substitute suggestive symbolism for the most dynamic feature of any art—motion. Now however, we can make use of actual motion, and through its proper use we can produce works of art which will without doubt surpass any masterpiece the world has ever seen. But please note this carefully—This masterpiece will not be a mongrel child of photography and drama! The drama involved will be that of pure motion, and not a theatrical scene enacted before the camera. It will be, as Colonel Winton of the Amateur Cinema League, says, "Unlimited motion dramatically applied!"

The photo-play as we have it today, while of incalculable value through its enrichment of national recreation, is not nor can ever be pure art! The only conception of the present day photo-play is in regard to its value as a drama, and in this motion photography has no part except that of recording medium. There is little motion picture art involved. The artistic motion picture will have little more in common with theatrical drama than has the masterpiece of painting.

So much for the consideration of the motion picture and its place in art. This has been given merely to stimulate a new line of thought. The writer is perfectly well aware that practically every reader of this book intends to prepare a scenario and produce a photo-playlet. In this you have his entire sympathy, for even if not pure art, this work is very fascinating and provides an endless fund of clean, wholesome amusement which returns tangible rewards in the form of the film which may be kept and enjoyed for a long time. In this respect amateur motion picture photography stands alone. It provides two-fold pleasure,—that of production and that of projection and viewing the completed film.

There is no reason for anyone to hesitate in purchasing an amateur motion picture camera, for it is absolutely more simple and easy to make good motion pictures than

it is to make good still pictures. With the average good quality still camera there are eight shutter stops and eight automatic shutter speeds, making possible sixty-four exposure combinations without regarding time exposures. In the average amateur motion picture camera there is one fixed shutter speed, and usually only six or seven stops, making at most seven exposure factors, which will give adequate control for all subjects within range of the camera's capability. In other ways the cameras have been so simplified that it is quite the usual thing for the average amateur to make a success of his very first film, a thing almost unheard of in still photography.

CHAPTER TWO

MOTION PHOTOGRAPHY AND THE MOTION CAMERA

Before going directly into the consideration of the cameras and other apparatus used in motion photography, let us consider the subject in general. There are several intensely interesting points concerning the reproduction of motion with which many amateurs are not at all familiar.

There is little doubt that motion pictures were known to the ancients. There are several passages in the classics which clearly refer to either motion pictures or animated figures and the supposition is that the reference is to the former as we know that the principle of the persistence of vision and its application to a mechanism for the reproduction of motion were known to Aristotle.

The logical beginning is the cause of the illusion of motion and then the mechanism of that illusion; for we must remember that moving pictures do not exist. The motion picture gives us an illusion of motion which is pure illusion and which depends for its existence upon our defective vision.

Persistence of Vision.—Without going into a discussion of the physiological reasons, we know that the human eye continues to see any object for an appreciable length of time after that object has disappeared, and this period has no relation to the speed of light travel. It is a purely physiological reaction. The classic experiment of the spark in the dark demonstrates this easily. For the benefit of those who are not familiar with this experiment, it may be explained that a spark or other glowing light when whirled in the dark appears, not as a travelling point but as an arc of a circle. If the whirling is made rapid enough, this arc will extend into a full circle. As we know that the point can be in but one place at a time we are forced to acknowl-

edge that the eye continues to see this point after it has left its old position, *but it sees the new position instantly,* therefore we have the phenomenon known as persistence of vision.

History of Cinematography.—At some period in the dim ages of the past, some toga clad philosopher studying in a somber cell imagined the effect of substituting one figure for another so quickly that the persistence of vision would cover the interval of change. After tedious experiment and repeated trials this was accomplished and the philosopher had the keen joy of seeing figures simulating the motion of human beings.

Centuries later when the savage hordes from Asia rolled over Europe, practically extinguishing the last spark of civilization, this knowledge was imprisoned in mouldy scrolls rotting away in neglected cells, but as civilization again gained impetus these ancient scrolls were unearthed and philosophy once more engaged the attention of men.

Who stumbled upon these records of the experiments relating to the persistence of vision? We do not know, but we do know that in the seventeenth and eighteenth centuries the little "Wheels of Life" were well known, and that many children, and adults too, of noble birth were amused by these ingenious toys. Therefore we know that motion pictures as such are almost as old as civilization, and also that they were and would still be of only incidental importance were it not for the merging of the photographic process with this principle.

The Nineteenth Century saw the birth and development of the photographic process. To join this with persistence of vision required some process whereby a series of similar but progressively changing photographs could be exposed from a single viewpoint, and a second device whereby this series could be exhibited. This was a problem comparatively simple, or would have been had it not been for one condition which was imposed by natural law. The complete cycle of showing the photograph and changing it to the next must be done within a time not exceeding one-tenth to one-twelfth of one second, for such is the duration of persistence of vision!

This problem was attacked by many men, but the production of the first photographic motion picture, the invention of the first mechanism to take and reproduce motion pictures in the modern method and the first public exhibition of both forms of motion photographs belong to Americans. Edward Muybridge made the first motion photograph(s) upon glass plates and exhibited them at the Chicago World's Fair. His discovery was to a certain extent accidental as he made the plates in an endeavor to solve certain questions concerning the motions of a horse when racing, and it was made as a result of a commission from certain racing stable owners to make a series of photographs to settle a stable argument.

The physical limitations imposed by the glass plate led to the invention of a flexible support for the emulsion. Experimenters in England and France were helping, but many of them worked with cheaper supports. It was in the United States that practical celluloid films were first made available for motion pictures on a commercial basis, by George Eastman. It was held that Rev. Hannibal Goodwin's American patent on celluloid films was a basic one only. Shortly after, in the early nineties intensive development took place in apparatus for using this film for taking and producing motion pictures, Thomas A. Edison and C. Francis Jenkins being among the most active pioneers.

From this point the development of the motion picture was normal, but due to its great cost both as to apparatus and maintenance it never proved truly popular as a form of amateur photography. While each individual photograph upon standard film represents only about 2/3 of one cent, completely finished, it must be remembered that sixteen of these photographs are exhibited each second, and the cost per second is about ten cents. In short the standard reel of one thousand feet represents a minimum outlay of about one hundred dollars.

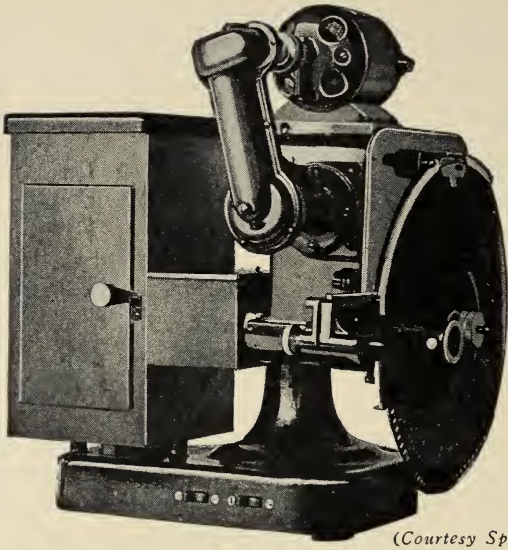
The apparatus for taking and projection was also expensive. Why? There must be two protective casings for the film. The film must be fed steadily forward at the rate of one foot per second. Midway in this forward travel the motion is changed from uniform to intermittent and back

to uniform. The intermittent motion holds the film absolutely motionless for approximately 1/32 of a second while it is being exposed to the light. During the 1/32 of a second during which all light is excluded from the camera, the film is advanced a distance equivalent to the width of one frame or individual photograph. This is ¾ inch in standard film and 1/40 foot in substandard. This distance of forward travel must be exact or a screen dance would result. After passing this the film again moves forward at a uniform rate and is finally wound up upon a receiving spool. It is evident that a mechanism which will act so rapidly and with the necessary accuracy must necessarily be expensive.

Thus the status of the standard film as used for theatrical projection is fixed, nor is there any indication that there will be a change in any of the basic mechanical points. There are minor improvements brought out from time to time and these are to be expected, but basically the standard motion picture apparatus will consist of a mechanism which will automatically expose successively a series of film areas. In doing this it is necessary that the film be stopped while the exposure is being made, and at the same time the film must be fed into the mechanism which alternately moves it forward and stops it. Finally the film must be removed from this mechanism. Any mechanical arrangement which will do this will make a motion picture.

As this is the extent of the limitation imposed, many variations of the ribbon are used, and have been used in the past to photographically simulate motion. Most of us have seen the "flip" books, small booklets of pictures which, when the leaves are allowed to slip rapidly from under the thumb, give an illusion of motion. The device is still used in certain advertising work. Then there were the zoetropes, and similar motion picture toys, but none of them embraced principles which could be practically applied to the making and projection of motion pictures by the photographic process.

Non-Ribbon Films.—One of the first departures from the orthodox ribbon film was the disc film. This is a large



(*Courtesy Spiro Film Corp.*)
The Spirograph projector which makes use of a disc rather than a ribbon of celluloid for supporting the individual frames of the motion picture.

disc upon which the tiny individual photographs are arranged spirally. This method has been brought out periodically, and even now there is a firm which is preparing this form of motion picture for the home. In the present

(*Courtesy Spiro Film Corp.*)
A "Spirograph" film recorded upon a disc of celluloid.

form no camera is offered, only the projectors and films or discs being offered for sale. They are quite satisfactory, and by some are preferred to the ribbon film. Naturally there is no rewinding to be done. However, this form of film is not subject to edition, titling and other alteration so often necessary, so that this form of apparatus is not as popular as the usual form.

Another company made an equipment using broad bands of film, which travelled around the interior of the camera, the lens dropping slightly with each exposure so that when the band was exposed the result was a band of film perhaps two feet long, ten or twelve inches wide and joined to form an endless band upon which the individual pictures are arranged in a continuous descending spiral. This apparatus was offered complete with both camera and projector. This apparatus did not prove popular either because it excluded the most essential part of after treatment of the film, the editing and title insertion. These are things which the amateur likes to do for himself.

Paper discs for use in conjunction with phonograph records were introduced, but never placed upon a successful commercial basis. These "records" were projected by reflection as in the case of the common "postcard" projector. This requires a tremendous incident light, due to the great enlargement necessary in projection.

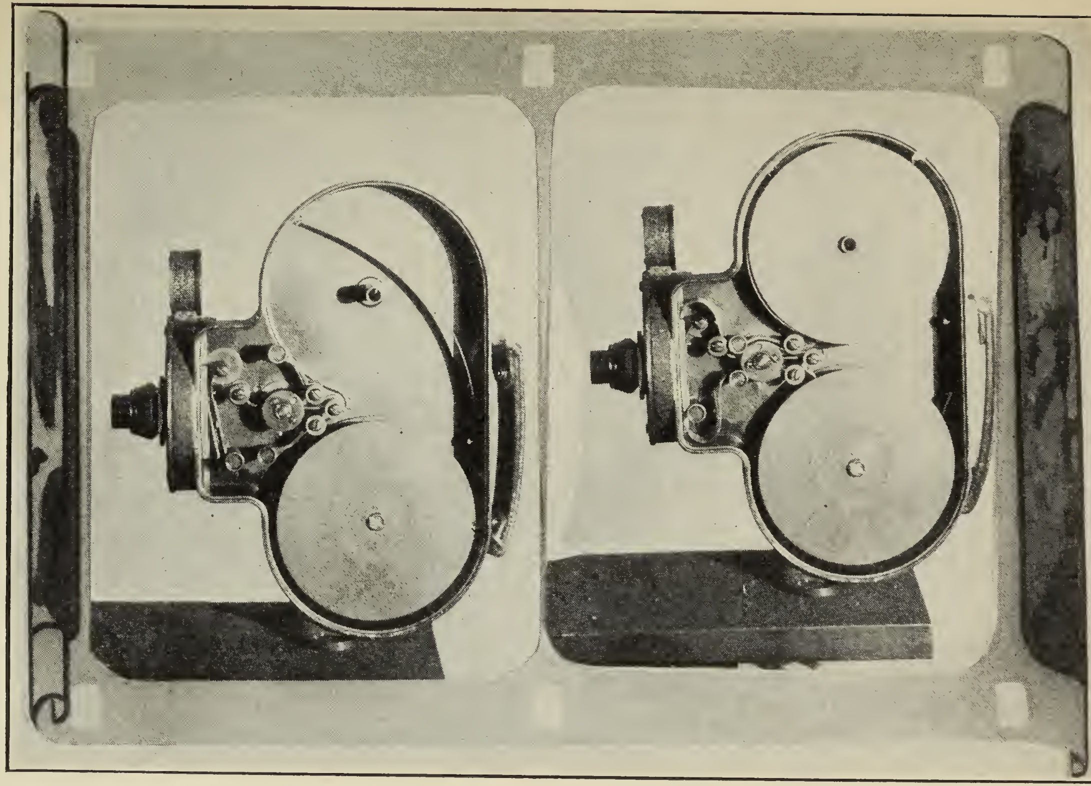
Experiment after experiment was made trying to popularize the motion photographic process for the amateur, but for several years there was no marked success. The movette, a small camera using a special 17½ millimeter film was fairly successful, but did not live. About the same time the Actograph was introduced. This was one of the most perfect small cameras ever built and was in fact superior to some present day models in many ways, as it made use of the professional outside magazines, had the reverse film travel and other professional features. This was also made for the 17½ millimeter film. It was later changed to take 16 millimeter film but it has not yet been placed upon the market.

28 Millimeter Film.—Perhaps the first commercially successful amateur film to be brought out was the 28

millimeter gauge Pathescope and Victor Safety film. These films were made less than standard width, not for the sake of economy, but to insure that only "safety" or slow burning film could be used in the projectors provided. The Pathescope film had the usual four perforations on one side of each frame but along the opposite edge of the film there was a single perforation placed exactly opposite the frame line. This was used to provide automatic framing. These films were used principally as "library" films, although several cameras were sold for use with this film.

16 Millimeter Film.—Time after time, efforts were made to bring out a successful amateur film, but these met with only questionable success until not many years ago the Eastman Company announced the 16 millimeter amateur film and the accompanying apparatus. The aggressive advertising campaign of the Eastman Company placed the new 16 millimeter film upon a firm basis. Almost immediately after this the Pathé Company of Paris brought out their amateur film which, while it had the same frequency, namely forty to the foot, was considerably narrower, namely 9½ millimeters. The difference in gauge was due to the difference in perforation, the Pathe film lacking the wide perforation bands on the sides of the actual picture space.

This substandard film gained favor slowly, and it must have failed miserably had it not had the support of such financially strong organizations as Eastman and Bell & Howell who actually fought financial losses in the production of their apparatus. To-day, amateur cinematography has been proven. It is accepted as a necessary part of American life. Naturally new equipment is jumping into the fore, but the leading instruments are those made by the first three companies who made apparatus when the first 16 millimeter film was introduced, these are Bell & Howell, Eastman and Victor. All three are old established firms. Bell & Howell made professional motion picture cameras, and established the first motion picture mechanical standards. Eastman is the world's pre-eminent manufacturer of photographic supplies while Victor is known wherever lantern slides and lantern slide projections are used. To-



1. The Victor camera interior showing mechanism open ready for loading.

2. The Victor camera interior showing film threaded ready for operation.

day these companies offer apparatus which is without doubt infinitely superior to that offered by most competitors here and abroad for the use of 16 millimeter film.

There is little choice among these 16 millimeter and the Pathe 9½ millimeter cameras, except as individual advantages appeal to the prospective purchaser. In the following descriptions we shall give brief specifications and descriptions bringing out the salient points of each instrument. Thus the reader, if he does not own a motion camera, may select that instrument which offers advantages which he believes will best solve the peculiar problems which confront him.

THE MOTION PICTURE CAMERA.—In order to select a motion picture camera we must have a general idea as to the requirements of *any* motion picture camera. In the first place we have the *box*, this is the framework inside which the mechanism operates. This box must be durable to withstand wear, it must be rugged to prevent injury from shocks and jars, it must be light in weight so that it may be carried without fatigue, it must be attractive in appearance and finally it must be light proof. If all of these considerations are fulfilled the remaining details are of no great moment.

The camera must have a film advancing mechanism. This consists of an upper spindle for the film spool, an *upper sprocket* which pulls the film from the upper spool, an *intermittent* mechanism which advances the film past the aperture, one frame at a time, an *aperture plate,* which is a polished metal plate against which the film is pressed during exposure. The *aperture* which is cut in this aperture plate is just the size of the frame or individual picture. The *pressure plate* presses the film against the aperture plate. The pressure plate is a part of the *gate* which opens to allow the film to be placed in the *film race.*

Beneath or past the gate is a second or *lower sprocket* which draws the film from the gate and finally the *take-up* mechanism which winds the exposed film upon the empty lower spool.

It may be remarked that in most modern cameras the "Upper" and "Lower" sprockets are either two sprock-

ets mounted side by side upon a single shaft or both are combined in one *master sprocket* the upper face of which serves as the upper sprocket with the lower face acting as the lower sprocket. These two arrangements provide exact synchronism between the two feeds.

In front of the aperture, the *shutter* rotates. In amateur cameras this shutter is a metal disc from which a certain sector has been cut. The angular measurement of this sector varies from 135 to 220 degrees. This rotating disc alternately obstructs the light and permits its passage.

In order to function, the camera must have a *lens.* This may be mounted in a *fixed focus* mount or a *focussing mount.* In the former, the lens does not have to be adjusted for different distances, but does not give such fine results as does the latter which is accurately set for each different subject. It may be remarked that the focussing model can be set for use as a fixed focus model, thereby combining the advantages of both in one instrument. This will be discussed further in the chapter devoted to lenses and in the Appendix.

In addition to the parts mentioned there are certain accessories such as the *film meter* which shows the amount of film exposed, the *level* which indicates the camera position with regard to the horizon, *stop motion* or single exposure devices, *slow motion* or *high speed* attachments, *variable speed* controls, *title writers, filters, vignetters, mask boxes, prismatic focussing devices, focussing microscopes,* and others without end. Some of these are built in, integral with the camera, others are added to the instrument by the owner. In addition, the separate accessories such as case, exposure meter, monotone filter, range finder and so forth are quite essential. Each will be discussed in its proper place, and instructions for use given.

In this country the amateur purchasing a camera for use with substandard film will choose from these models: Victor, Pathex, DeVry, Ciné-Kodak, or Bell & Howell (Filmo). There have been hints of even other amateur motion picture cameras coming and the author has had the opportunity of seeing at least three inventors' models of new cameras which worked very well indeed, but at this

time none of these three has yet made its appearance upon the market.

(*Courtesy Pathex Inc.*)
The Pathex Camera. The smallest automatic motion picture camera available.

PATHEX CAMERA.—As the Pathex is the smallest, both in film size and camera size, we will start the specific descriptions with it. The Pathex camera is known all over the World outside of the United States as the Pathé Baby. The film has a frequency identical with that of the 16 millimeter film, namely forty to the foot, so that the two films are the same foot for foot, but the Pathex frame has a width of only 8½ millimeters as compared with the 10½ of the 16 millimeter gauge. The maximum capacity of the camera is thirty feet, or the equivalent of 75 feet of standard film. Due to the instant loading feature, this limited capacity is not objectionable.

The camera has no sprockets, the cam driven claw providing the film movement from the upper magazine chamber and the take-up providing the film motion from the claw to the lower magazine chamber. The film is sold in a double compartment magazine with a short section of the film exposed. This magazine is dropped into place inside the camera, the door closed and the camera is ready for operation.

The perforations in the film are located in the center of the ribbon and between the frames, thus giving an abso-

lutely central pull with a single claw. This is a feature of this type of camera.

PATHEX CAMERA

CONSTRUCTION—All metal, morocco covered, nickeled trim.

SIZE—With spring motor attached 3 x 3⅜ x 4½ inches. Without motor the size is 1½ x 3⅜ x 4.

WEIGHT—Complete with motor, 3 lb., 6 oz.

CAPACITY—30 feet Pathex substandard, 9½ millimeter film in Pathex magazine.

FINDER—Iconographic showing exact field.

LENS—20 millimeter, f 3.5 ciné-anastigmat, fixed focus. f 1.9 also available.

SHUTTER—180 degree rotary disc.

INTERMITTENT—Pathé harmonic cam, actuating single central claw.

TAKE-UP—Positive, enclosed type.

METER—By hundreds of frames up to 1200.

MOTOR—Morocco covered to match camera. Attachable and detachable at will, allowing use of hand crank. Release may be latched in operating position allowing operator to enter picture.

CASE—Heavy leather for camera, motor and 4 extra magazines of film.

TRIPOD—None required, but any good metal tripod will answer.

FILM DEVELOPMENT—First cost of film includes reversal and return to owner.

All of the other cameras mentioned in this chapter are for use with the sixteen millimeter substandard film. This film has gained recognition as the standard film for amateur work in this country, and practically all new cameras introduced are designed for use with it.

The sixteen millimeter film is distinctly an Eastman introduction as it was designed and manufactured when practically all other firms were trying to make the 17½ millimeter the standard size for amateur use. The 17½ millimeter is the film known in Europe as "half-normal" and is just one-half the width of standard film. This film

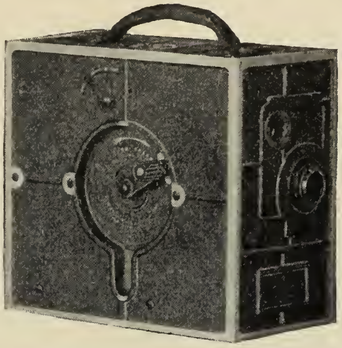
is at times a piece of standard film cut in two, lengthwise, with the usual standard perforations running down one side, while in other cases the film has been doubly perforated as in the case of the modern 16 millimeter.

(*Courtesy Eastman Kodak Co.*)
Ciné Kodak Model B with f 6.5 lens equipment. This is one of the most popular of the Ciné Kodaks.

When the 16 millimeter film was introduced, the Ciné-Kodak was introduced. This camera was a marvelously made instrument, and was almost a professional camera in miniature. It was hand driven, and a tripod was supplied. About the same time an automatic camera was introduced which was of smaller size and the public reaction was toward the "easier" model. The Ciné-Kodak was then supplied with an electric motor, but the Ciné-Kodak did not really prove popular until the introduction of the present model B. This model has swept the country and has become as commonplace as the still Kodaks. The hand cranked model "A" is still sold for the use of the specialist and serious cinematographer and in his hands proves an instrument of precision.

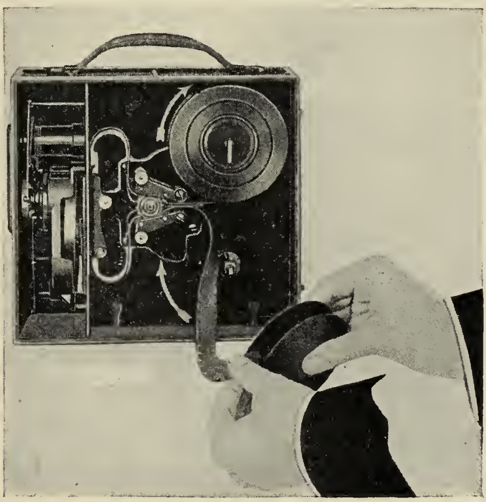
CINE-KODAK MODEL "A".—This is among the finest cameras ever manufactured for amateur motion pictures. It is even more suited to research and scientific work. The camera is of rectangular design, and hand cranked. It has a direct focussing tube through the camera and a reflecting finder for using the camera at low level. As it is a special purpose camera it is equipped with special lenses. One, the f 1.9, is made for use under adverse lighting conditions,

the other, an f 4.5, 3-inch, for medium power telephoto work. A special finder lens is supplied for use with the



(Courtesy Eastman Kodak Co.)
Ciné Kodak Model A. This is the first successful 16 m/m camera produced and is still a great favorite with many advanced amateurs.

3-inch lens. By means of special attachments which screw to the side of the camera the gear ratio is changed for single exposure work and by means of a similar attach-



Interior of the Ciné Kodak Model "A"

ment the mechanism is speeded up to four times normal, giving slow-motion pictures. These attachments will appeal to the trick worker.

A special tripod is supplied for use with the Ciné-Kodak "A." This is built somewhat like the familiar Crown tripods, but it has a metal head which incorporates a friction tilt and panorama. Due to its light weight this tripod is finding favor with owners of practically all types of motion picture cameras except the professional models.

CINE-KODAK MODEL "A"

SIZE—4⅝ x 8 x 8⅝ inches.
WEIGHT—7¼ pounds.
CONSTRUCTION—Aluminum.
CAPACITY—100 lineal feet of 16 mm. film, equivalent to 250 feet standard gauge film.
LENS—Kodak Anastigmat f 1.9 interchangeable with 3-inch f 4.5.
FINDERS—Reflecting, for low-level work and telescopic through body of camera for ordinary tripod work. Adjustable for field.
SHUTTER—Fixed, rotary disc.
INTERMITTENT—Special double claw Kodak movement.
TAKE-UP—Positive, inside.
METER—Dial at rear registers feet exposed.
FOCUS—By dial and pointer at rear of camera.
MOVEMENT—Hand driven, single picture, normal speed, superspeed.

CINE-KODAK MODEL "B"

CONSTRUCTION—Metal covered with morocco leather; f 1.9 model in ostrich leather at $75.00 additional.
SIZE—About 3 x 5½ x 8¼ inches.
WEIGHT—5 pounds, loaded.
CAPACITY—100 feet 16 millimeter film, equivalent to 250 feet standard film.
FINDER—Two provided, one direct (Newtonian) and one brilliant reflecting type.
LENS—Optional, f 6.5; f 3.5; f 1.9.
SHUTTER—Standard, fixed, rotary.
INTERMITTENT—Special Kodak claw movement.
TAKE-UP—Positive inside.

METER—Registers in feet.
FOCUS—Universal or by spiral mount.
MOTOR—Built-in with winding crank permanently attached. Release may be locked in operating position when desired.

(Courtesy Eastman Kodak Co.)
Ciné Kodak Model B with f 3.5 lens equipment.

In point of age, the Bell & Howell Filmo and the Ciné-Kodak "A" are the leaders. The Filmo was introduced shortly after the introduction of the 16 millimeter film and since its introduction, no great change has been made in the basic design. The general appearance is the same as it was when first introduced. Improvements have been along the line of making the camera more flexible by the use of interchangeable lenses and other accessories.

THE FILMO CAMERA

CONSTRUCTION—All metal finished in black, crystal enamel.
SIZE—About 3 x 6 x 8, irregular shape.
WEIGHT—4½ pounds.
CAPACITY—100 lineal, 250 equivalent feet 16 millimeter film.
FINDER—Special Bell & Howell spy-glass type.

LENS—Optional from 20 millimeter to six inch and from f 1.9 down in speed.

SHUTTER—Rotary disc, opening 216 degrees in one model, 180 degrees in others.

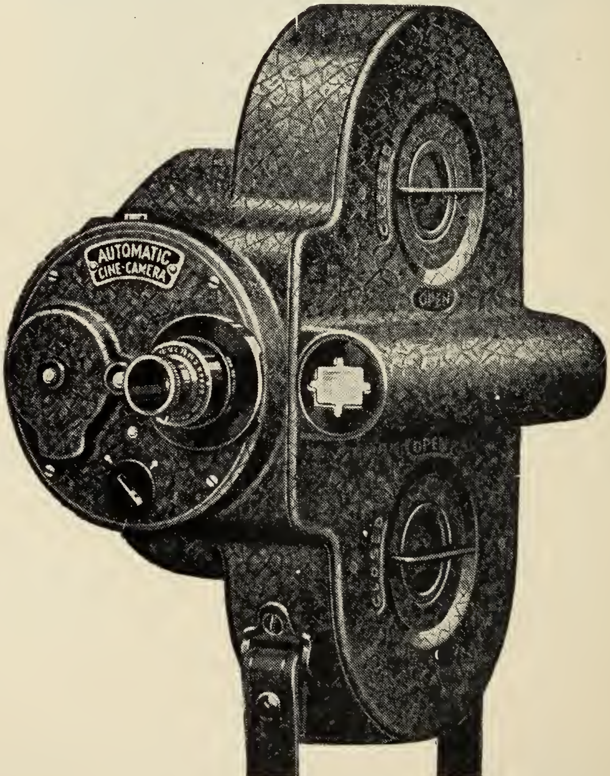
INTERMITTENT—Special single claw movement.

TAKE-UP—Positive, inside.

METER—Registers in feet.

FOCUS—By scale with Bell & Howell special micrometer focussing mounts, visually by focussing magnifier or visually in camera by reflex focusser.

MOTOR—Built-in, spring power, detachable winding key.



(Courtesy Bell & Howell)

The Filmo camera, the first automatic camera made for use with 16 m/m film.

The Filmo is built in four models. One of these will operate at either 8 or 16 exposures per second and is the standard model. The double speed model will operate at

either 16 or 32 frames per second, giving a slight degree of slow motion, the three speed model will operate at 12, 16 or 24 frames per second, giving some leeway in the matter of exposure and speed control while the superspeed model operates only at 128 frames per second for extreme slow motion.

One of the three manufacturers who made 16 millimeter cameras coincidently with the introduction of the 16 millimeter film was the Victor Animatograph Company. This company made a 24 millimeter model when the Pathescope was popular and had been making projection apparatus for years prior to this time.

The original Victor camera was a small, rectangular box with a fixed focus lens, a revolving disc diaphragm, and of the simplest construction, yet it delivered the goods, and some of the best substandard film the writer has ever seen was a product of one of these little boxes. The manufacturer, however, an earnest photographic experimenter, was not satisfied. He started designing a new camera and now this camera has been placed upon the market. It is made in irregular shape, the shape conforming to the shape of the enclosed mechanism, which seems to be the accepted shape for American made motion picture cameras, for there are at least two others of shape similar to the Victor and the Filmo now being developed.

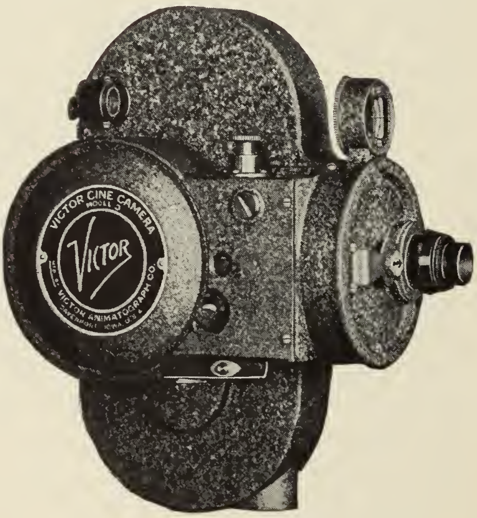
This camera has many unique features, some of which have not been before combined in any camera, either standard or substandard. The motor is detachable, and the camera may be used with either the motor drive or the hand crank. The motor spring is of the double type, giving instant, uniform, smooth response. The action starts and stops at full speed, yet with an accelerated motion on the first frame which makes possible this full speed start without injury to the film, even when using superspeed for slow motion.

The finder may be instantly set to indicate the field for any distance beyond three feet, yet no masks, lenses or other attachments are used for this purpose. A level seen through the finder aids in making truly horizontal pictures. An exposure meter is built into the camera it-

self and, last but not least, the film meter, which does not require setting, indicates the amount of *unused* film left in the camera.

The lens thread is standard, making possible the use of any standard lenses and Goerz effects. The film is self-aligning in the film race, making threading very easy and simple. Threading takes about thirty seconds.

The starting button may be rotated to control the speed of operation. An arrow engraved on its top indicates the speed of operation, which is half normal, normal and superspeed. The fourth position of this button locks the mechanism, preventing accidental exposure of the film in the camera. It is unusual for one camera to combine half, normal and superspeed without using any accessories to accomplish this purpose.



The Victor Camera. Model No. 3.

SPECIFICATIONS FOR THE VICTOR MODEL NO. 3

CONSTRUCTION—All metal, finished in crystal black enamel.
SIZE—Over all projections 3¼ x 6 x 8 inches.
WEIGHT—4¾ pounds.
CAPACITY—100 lineal, 250 equivalent feet of 16 millimeter film.

FINDER—Adjustable for all distances from three feet to infinity. Level visible in finder.

LENS—Optional. f 3.5 or f 1.8, both 25 millimeter focus supplied with camera. Lenses from 1 to 6 inches focal length and from f 1.5 down in speed may be used.

SHUTTER—Rotary disc type, 220 degree sector.

INTERMITTENT—Special Victor type which will not tear perforations.

TAKE-UP—Positive, built in.

DRIVE—Automatic by motor or manually with crank in same model.

MOVEMENTS—Forward, by motor at half speed, normal speed or superspeed. By hand at any desired speed. Also single frame for animation and stop motion effects.

EXPOSURE METER—Built in.

FOOTAGE METER—Fully automatic, does not have to be set. Indicated amount of *unused* film in camera. Correct reading with either 100 or 50 foot spool.

FOCUSSING—By scale on lens mounts, visually with reflex focusser or sliding base.

MOTOR—Double spring type providing smooth, even pull. Governor keeps speed at uniform rate. Starts and stops at full speed. Quiet in operation. Cased in detachable housing. Fully controlled by finger release button. Release may be locked in operating position. Turning release gives 3 speeds and lock.

The Victor is built in one universal model for all types of work, including single exposure, stop motion, animation, time-condensation, titles, normal and slow motion.

The latest addition to the line of sixteen millimeter cameras available is the DeVry sixteen millimeter model.

For years the DeVry Corporation manufactured the world's leading projector, and recently they introduced an automatic, standard gauge motion picture camera. This camera, of regular shape and beautifully finished, made a very attractive appearance. Trial proved it to be the equal of any motion picture camera ever produced and its many unique features quickly made it a universal favorite. So

great was the success of this camera that the manufacturers were practically forced to produce a model for the sixteen millimeter film.

In accordance with DeVry principles this camera was not announced until the experimental models had been pronounced perfect. Now, however, almost coincidentally, with the publication of this book, the announcements are made public, and it is evident that the camera has been worth waiting for. It incorporates exclusive DeVry features and also those which are recognized as being the most modern.

In appearance the camera resembles the standard gauge model. It has the same rectangular shape, the same leather-like, imperishable finish and the same trim attractiveness throughout.

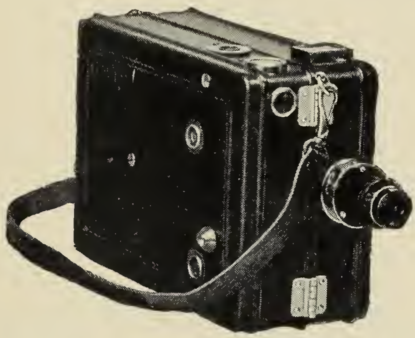
This camera is made in two models, one a plain model for straight work, equipped with a one-inch f 3.5 anastigmat lens. The other model is equipped with an arrangement whereby it may be used for either normal or slow motion pictures, and a one-inch lens of high aperture. It appears that the modern camera must be capable of producing slow motion if it is to appeal, for the interest in this work is growing by leaps and bounds. There is a fascination in slow motion which the average amateur cannot resist. Due to the use of the DeVry double, "balanced" spring motor, the camera runs without vibration even at superspeed. The standard DeVry camera has proven the value of DeVry spring motors.

These cameras are, of course, arranged so that any desired ciné lens may be substituted for the one supplied. This includes the range from one to six-inch focus and from f 1.5 down in speed. Finally the camera is made throughout in keeping with usual DeVry quality, a point which is fully appreciated by everyone familiar with motion picture equipment.

SPECIFICATIONS OF THE DE VRY CAMERA

CONSTRUCTION—Metal throughout, finished in imitation leather grain.

SIZE—$2\frac{1}{2}$ x $5\frac{1}{2}$ x $7\frac{1}{2}$.
WEIGHT—4 pounds.
CAPACITY—100 lineal, 250 equivalent feet of 16 mm. film.
FINDER—Two supplied—Telescopic spy-glass and direct vision types.
LENS—Any from 20 mm. to 6-inch focus, from f 1.5 down in speed; 25 mm. f 3.5 standard.
SHUTTER—Rotary disc, 180 degree opening.
INTERMITTENT—Cam and shuttle, special.
TAKE-UP—Positive, inside.
METER—Registers exposed film footage.
FOCUS—By micrometer focussing mount.



The DeVry automatic motion picture camera. This is the latest addition to the family of 16 m/m cameras.

MOTOR—DeVry double spring, counterbalanced type for driving camera at all three speeds without any vibration.
OPERATION—Automatic, spring drive at half-normal, normal and superspeed.

(There are several cameras using sixteen millimeter film which find wide favor in Europe, such as the Oxford, Ciné-Geyer, Ciné-Nizo, and others as well as those such as the Ernemann which use the $17\frac{1}{2}$ millimeter film.

As these are not widely used in this country, detailed specifications and descriptions will be omitted.)

We are inclined to think of the motion camera as being merely a camera with the motion added. This is not at all true. The motion camera is an instrument for record-

ing motion. Motion requires an appreciable interval of time for its occurrence and similarly for its recording. In still photography we are not at all concerned with time. The still photograph is made almost instantaneously and therefore the process and the result both have nothing of the time dimension. On the other hand, the motion camera records motion and therefore change. The time dimension is the most important in motion photography. Thus, instead of a mere camera, let us regard the motion camera as a scientific light recording instrument.

As such, we will instantly realize that fact that in order to properly record the variety of changes which the time element introduces, it will often be necessary to change the camera itself. This is done in one of two ways, either making adjustments of the camera itself, or by the use of accessories.

The modern motion camera is usually strictly limited in its output if no accessories are used. In this respect it may be compared with the scientist's microscope. The judicious selection of the accessories for any camera will actually treble or quadruple its value to the owner and user.

The actual photographic accessories are few in number. There is the choice among lenses of course, as will be discussed later, the very necessary range finder, the exposure meter which will be discussed in the chapter dealing with exposure, and such items as cases and other protective appliances whose purpose is too obvious for detailed discussion here.

A tripod is a useful accessory for any motion camera. The camera can be operated without the tripod in most cases, but whenever circumstances make it necessary the tripod should be used to give the desired steadiness to the picture. Fortunately the modern automatic camera makes it possible for us to use a light weight tripod, but even so the stand selected should not be too flimsy. A good, steady tripod will often repay its cost many times over in increased film quality. However, the tripod is not really a necessity with the modern automatic camera.

The still photograph which excites our admiration as it

hangs upon exhibition bears but little resemblance to the original print. The still photograph is amenable to a tremendous amount of manipulation, but the motion film comes from the developing tank in almost the same condition it will keep throughout its useful life. Our manipulation, our retouching, our additions and suppressions must be made *before the film is exposed.* For this purpose we make use of that most valuable accessory, the "Effect Set." This consists of an iris diaphragm set about two

(*Courtesy Burleigh Brooks*)
The Triax tripod, one of the lightest rigid tripods made, it is automatic in action and may be set up in a very few seconds.

inches in front of the lens, a long funnel-shaped tube of metal in front of this iris, terminating in a rectangular opening slotted to take cardboard slides or "masks." The iris gives us a space control in circling in and out, the funnel gives us an excellent sunshade resulting in a clear, brilliant, snappy film, and the mask box allows us to use chiffon-edged masks for softening the margins of the pictures, and masks for double and multiple exposure, as will be explained later.

While we may depend absolutely upon the range finder and the calibrated lens mount to give us a proper focus, we cannot expect the finder, which is placed above or at one side of the lens, to give us a field of view which exactly coincides with the lens field. On the other hand, the beauty of our "framing" or of our composition depends upon the exact location of the component parts of the composition

within the border of the frame. To secure this exact orientation, we make use of the sliding base which places a focussing telescope in the position to be occupied later by the camera lens system, or by the use of the reflex focussing device. The latter is one of the most valuable accessories yet placed in the hands of the amateur.

Then there are many times when a film is desired of an object very close to the camera, so that we may secure a tremendously enlarged image upon the screen. To do this we have to increase the lens extension. With the reflex focussing device mentioned above the lens extension may be increased considerably so that objects only a few inches in front of the lens may be photographed successfully, giving us screen images which are hundreds of times life size.

In addition to these, new accessories are added constantly, and, as has been said, there are accessories in the special fields, lenses and filters as optical accessories, accessories giving better projection, accessories which are vitally necessary in edition and titling and accessories for interior cinematography. In fact the status of the amateur cinematographer, and quite often the quality of his productions, may be estimated by the accessories which he uses.

Finally there are the home-made accessories. The use of a home-made accessory does not indicate a penurious nature, but rather an inventive one which designs accessories which have not yet been made commercially available. Practically every true experimentally inclined amateur will make use of at least one home-made accessory in his photography, cutting, developing or projection.

With the camera selected and the necessary accessories at hand, we are ready to shoot our first film.

CHAPTER THREE

SHOOTING THE AMATEUR FILM

Each manufacturer includes with his camera and projector specific operating directions for that particular instrument. The owner can do no better than to follow these instructions. They will tell him everything he needs to know in order to load the camera, to make straight record shots of simple scenes, and to remove the film from the camera after exposure. Were this the extent of the usefulness of the motion picture camera there would be no use for this book. However, this is but the A-B-C, the natural scale, one might say, of true motion pictures. In order to secure the fullest satisfaction from the use of the camera, one must understand the instrument and be able to make the utmost of its possibilities. The ownership of a violin does not make a violinist nor does the ownership of the camera make a successful amateur cinematographer in the fullest sense of the word. One can learn to play chords upon a ukulele, after a fashion, in ten minutes. One can learn to expose motion film in a similar length of time. But the one is not a concert musician nor the other a successful amateur. Both have elementary knowledge which with a little study and application will bring real success, but the cinematographer has a far easier path to travel than has the musician.

Exposure.—The one vital factor in all photographic procedure is exposure. Before we can do very much in this work we must understand a few simple facts about light, both as to quantity and quality.

We all know that light will cause certain colors to fade. Light also acts in other ways and upon other materials. One of the most rapid actions of light is that used in photography where if light is allowed to fall

upon a prepared film for only such a short time as, in some instances, one one-thousandth of a second or less, that prepared film will be changed to such an extent that we secure from it a photographic reproduction, or a photograph.

Light has two photographic qualities, the intensity, or as we might say in popular language, the candle-power, and it has color. Color has nothing to do with photography, directly, but it is a visual index of the approximate photographic power of the light which is called the "actinic value." For example red and yellow do not affect the sensitive film to any extent, therefore it is difficult to make photographs of sunsets in which these colors predominate, and for the same reason the developing rooms are lighted with red lights. Thus, a very strong red light would not suffice for making a photographic exposure, while a comparatively dim white or blue light would serve. The reaction of the film to light is in an advancing scale which corresponds to the familiar rainbow colors; red is the weakest and violet the strongest color, speaking photographically. Thus red photographs as black while violet photographs white.

In photography we have three exposure factors. The first is the sensitivity of the film to light. That is, the length of time which that particular film must be exposed to the light in order to darken it. The second factor is the size of the hole in the lens diaphragm through which the light passes and the third one is the length of time during which the light is allowed to act. So a light of certain intensity (of a certain actinic value) is allowed to pass through a certain sized opening for a certain length of time to properly expose a certain sensitive film. This is the complication with which the pioneer photographer was confronted! How different it is to-day with the amateur motion picture photographer! He varies the size of the lens opening to correspond with the intensity of the light used and shoots. Simple, isn't it? How does he know the proper size of lens opening to use? He makes use of some kind of exposure meter. This accessory is so important that it deserves a paragraph or so all to itself.

Exposure Meters.—The exposure meter, so-called, may be a set of reference tables, a calculator constructed something like a slide-rule or it may be an actual meter which measures the intensity of the light falling from the sky or the intensity of the light reflected from the object which is to be photographed. It is obvious that both reference tables and calculating slide rules will give only average results, but as most of these calculators have been designed after a study of hundreds of test exposures, it may be assumed that the results represent the mean values of all of these tests. So nearly identical is the light intensity under certain given conditions that these calculators are quite satisfactory and thousands are in everyday use. They require a little time to operate and are not as convenient as some other kinds of meter, but their low cost makes them very popular.

The Harvey Motion Picture Meter is typical of the calculators. In this meter we have two sliding scales. We start by setting a pointer to indicate the correct geographical location and time of year. Setting this pointer changes the position of one scale. We then set a second scale adjacent to the first. The second scale carries a list of light conditions. The adjacent edge of the first scale carries the frequency factor, such as normal, one-half normal speed and so forth. It also carries indices indicating the height of the sun above the horizon, for use late in the evening or early in the morning. When these two settings have been made the meter is turned over. Here we find a series of "windows" arranged in horizontal and vertical rows. Each entire vertical row represents one diaphragm (lens) stop, ranging from f 1.9 to f 32. The horizontal rows indicate the subject, each row being given to one typical group of subjects. There are 10 diaphragm stops and eight classes of subject giving us a range of eighty readings. When the slides have been set we find that most of these windows are blank, but in some of them we see small dark spots which represent, respectively, sectors of discs equal to 180 degrees, 135 degrees and 90 degrees, the three most common settings for adjustable shutters. If we find that for a beach scene the 180 degree sector appears under 16,

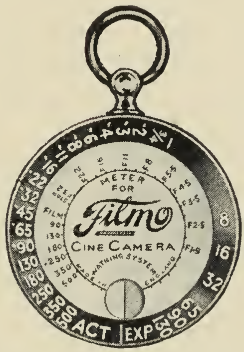
we know that we should use stop f 16 with a 180 degree shutter when photographing a beach scene. As meters give full readings the 180 degree sector can be used in determining the stop to be used with 170 degree fixed shutters. As practically all fixed shutters are either 180, 170 or 135 degrees, this meter is quite practical for use with fixed shutter cameras. The fact that this calculator has received the endorsement of many well-known studio cinematographers indicates that it is quite satisfactory.

Another type of calculator is the Rexo meter, made primarily for use with the substandard cameras. This meter was designed by Mr. Syril Dusenbery of San Francisco, and has found great favor in that it is both simple and reliable.

In trying to overcome the shortcomings of the calculator type, several meters have been brought out which measure the intensity of the light which falls upon the subject. Here we again run into some trouble. The light which falls from the sky is not an index of the exposure required, else we would give the same exposure to every type of subject under the same light conditions. Even the light which actually falls upon the subject is not a sure index. However, when we know such intensity, our problem of exposure calculation is tremendously simplified. With the Milner light gauge, we point the instrument at the brightest source of light which falls upon the subject. For subjects in bright sunlight we point the gauge directly at the sun, and for subjects in the shade we point it at the most brilliant portion of the sky which is visible from the position occupied by the object. When we do this a small opening covered with a brownish yellow film becomes brightened to a certain extent. We now turn a disc until a second opening just beneath the first assumes approximately the same color. When this is done we look at the lower side of the scale. Here we find five subject types, ranging from brilliantly lighted to dark subjects. Above the type which represents the subject before us we find the proper lens stop indicated.

Another meter which is used to measure the photographic power of the light which falls upon the subject is

the Watkins Meter, first popularized in the "Bee" type. This instrument does not look unlike a watch. Beneath the crystal is a movable scale in which is a small round opening. One-half of this opening is covered with a gray-tinted shield, the other half is open. Beneath this scale is placed a disc of sensitive paper which can be exposed portion by portion by slightly turning the bottom of the case. In use this meter is placed in the position occupied by the subject or in a position which is correspondingly lighted. A fresh portion of the paper is brought under the opening where it will begin to turn dark. Seconds are counted



Filmo actinometer for indicating proper exposure.

until the paper has the same general depth of tone shown in the permanent gray shield tint. This is known as the actinometer reading. Upon the left side of the rim of the case we see a series of numbers with the word "ACT." This means actinometer, and this series of numbers correspond to the number of seconds required to darken the sensitive paper. Upon the left side of the dial, adjacent to the actinometer scale, we see a column headed "Film." The numbers in this column refer to the speed of the film used and are an expression of a system of film speed testing known as the Hurter and Driffield method. The figures are commonly known as the H&D values. A small dot is placed opposite 250 indicating that the ordinary ciné film has a speed of 250 H&D.

Suppose that it took 150 seconds to darken the sensitive paper. We set the 250 film reading midway between 130

and 180. Now if we refer to the right side of the dial we see the usual diaphragm stops from f 1.9 to f 32, while on the right side of the rim of the case we see some figures marked "EXP." These figures refer to the exposure frequency, the actual values indicating the number of frames exposed per second. (Remember that normal speed is sixteen frames per second.) We find 16 on this scale and opposite it on the dial we see f 1.9. This indicates that we can only make this exposure with an f 1.9 lens. However, if we have a 2.5 or 2.7 lens we can run the camera at half speed and still get the film, for we see 2.5 opposite 8, which means 8 frames per second. This meter has proven very popular, but with it we are again measuring the light which falls upon the subject. At first glance this might appear to be the logical procedure, but the fallacy will be apparent upon consideration.

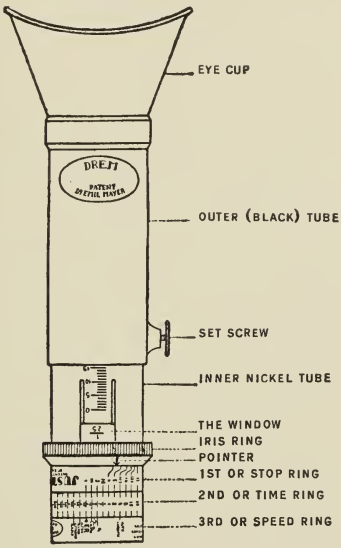
We have seen that light falling upon the sensitive film causes the photographic action to take place. The fact that this light, which does so affect the film, is reflected from the subject makes possible the formation of the image of the subject. Therefore, it is evident that the light with which we are working is solely the light reflected from those objects whose images will appear in the completed photograph. Now if we have light of equal intensity falling upon a piece of white cloth and upon black velvet, we have a great difference in the amount of reflected light. This makes the difference in the appearances of the cloths. Objects which are photographed are usually composed of a great number of shades of dark and light, and the general tone makes up a light, medium or dark object. It is obvious that an exposure calculated for the reflected rather than for the incident light will be the more accurate. For measuring the reflected light we use the extinction meter.

The extinction meters consist, usually, of round cases in which a disc revolves. This disc is quite transparent at one place and then gradually darkens until it becomes practically opaque. This opaque portion joins the transparent portion. This tinted disc or "optical wedge" is usually tinted blue. Now, upon looking through a peep hole provided for the purpose we see the scene before us

in monochrome. This helps us in judging the lighting, as the monochrome blue shows us the scene just as it will appear in black and white upon the screen, something which cannot be judged by the unaided eye until after long practice.

As we look at the subject through this meter, we turn the disc until all the detail has disappeared and we can see only the masses of the subject. If we now refer to the scales printed upon the meter we will see opposite the one-thirty-fifth shutter speed the proper diaphragm stop to be used.

We now encounter a curious fact. Hardly two people see alike. Vision varies greatly, but it would appear that



(*Courtesy Drem Products Co., Inc.*)
The Cinophot exposure meter, showing the various parts.

the difference is not one of sensitivity as it is of perception of detail. As long as no pathological condition exists, one individual will see a light at just about the same instant another will, but when it comes to distinguishing detail, one individual will see full detail before others can see any. So, in using the extinction meter, it was found that the readings made by various people were totally different. This, in turn, meant that each user had to become accus-

tomed to his individual meter. He would find by trial and error that appearance which gave him the best results and this he called the point of extinction.

This condition, in turn, led to the invention of the Drem Exposure Meters, of which the Cinophot is the universal motion picture meter. These meters are independent of all personal idiosyncrasy, and time after time the writer has seen tests made wherein several persons, many times those unfamiliar with the instrument, secure readings within one point of all the rest. Also under rigid tests in New York studios it has been proven to be absolutely accurate.

The meter itself is a short tube with an eyecup which to some extent resembles a pocket telescope. In use these steps are followed:

1. Loosen the set screw.

2. Pull out inner nickel tube at diaphragm collar, exposing a window in the nickel tube, just above the knurled iris ring. In this window appears the selective exposure time 1/25, 1/5, 4 or 30.

3. Turn the diaphragm ring to the left, counter-clockwise, in the direction of the arrow on the nickel tube. Each turn of one-quarter circle snaps one of the four basic observation figures, namely, 1/25, 1/5, 4 or 30, behind the time window, and places the same figure automatically in line of vision within the instrument. Assume that 1/5 is thus placed.

4. Turn diaphragm collar back to the right, clock-wise, about one-quarter circle, until meeting with a checking resistance. This opens the diaphragm fully. Do not force beyond that.

5. Remove eye glasses, if any. Place eye cup to the eye, excluding extraneous light. Close or shield the other eye. Point the instrument towards a bright light. The number which you placed at the time-window of the nickel tube will now be discerned, although more or less blurred, as a translucent figure within the instrument.

6. Telescope the nickel tube in or out, in a longitudinal sense, without removing the instrument from the eye, until the figure (in our example: 1/5) is sharply focussed.

7. Now tighten the set screw without undue force. This will keep the instrument permanently at the focus corresponding to your individual eyesight.

The case will accommodate the meter at any extension.

HOW TO MEASURE EXPOSURE

It is presumed that the "Adjustment for Individual Eyesight" has been duly performed.

8. Selection of Basic Observation Time: By revolving the diaphragm collar in the direction of the arrow on the nickel tube, the figure which corresponds to the specific light condition involved is placed behind the tube window and simultaneously within the instrument.

Sunlight, bright diffused light, very brilliant artificial illumination	1/25
Diffused daylight, overcast sky, shadow side, brilliant artificial studio light	1/5
Under heavy foliage, twilight, light interiors	4
Deep ravines, dense forest, night scenes, dark interiors	30

Always select the smallest usable time figure. Return ring to widest aperture of the iris diaphragm.

9. Place the instrument to the eye, and aim it towards the object which is to be photographed. Point the instrument towards that part which should be expediently and most carefully measured, usually the shadow details. For titles, small objects or animation, approach with the instrument as close as possible without obscuring the object. The meter will indicate the best possible balanced average exposure over its range of field.

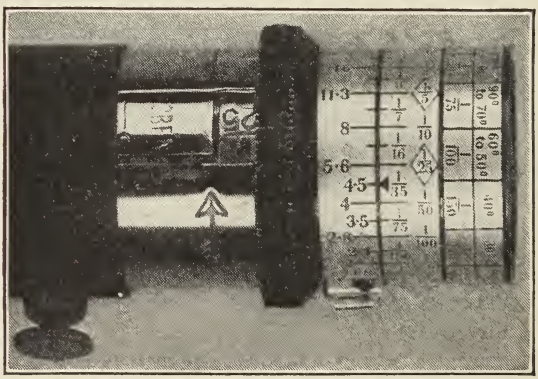
10. If, at greatest aperture of the iris diaphragm, the selected figure should not be visible at all, or just barely visible, then the next larger figure must be snapped in position by a turn to the left—this will automatically correct any error in the selection of the basic observation time. But do not employ any larger figure than necessary.

11. Close the diaphragm, which should make the figure invisible. If the figure remains visible even at smallest

aperture, then the next faster time number must be inserted, for example, 1/25 instead of 1/5. Then reopen slowly and very carefully until the figure just becomes plainly discernible and legible again, and not more.

This is the important and deciding point of the operation: The turning of the diaphragm ring must cease at the very instant when the reappearing figure just becomes visible, recognizable, emerging from the surrounding darkness. Would you not know which figure is to appear, you should be just able to read it within the instrument, and you are *not* to continue turning, thereby opening up wider, until the figure is restored to initial, fullest possible brightness.

12. Release the knurled diaphragm collar, lower the instrument and observe the position of the pointer on the beveled edge. It will point to a scale on the first ring, adjacent to the iris, which carries the conventional diaphragm marking in "f system."



(Courtesy Drem Products Corporation)

The Cinophot scales showing how the calculating rings are set. Note that 1/25 is the fraction shown in the window and that this same fraction enclosed in a diamond shaped enclosure is set opposite 5.6 the f. value indicated upon the exposure ring in this example. The black arrow head indicating 1/35 second, the normal exposure of most fixed shutter cameras is found opposite f 4.5 the correct setting. In Victor and Filmo cameras the opening indicated by 1/25, i.e., f 5.6 is used as these cameras have extremely wide shutter openings.

13. Turn the second ring, which bears the time figures, until the mark bearing the number observed in the instrument coincides with the mark of the aperture ("stop f")

to which the pointer on the diaphragm collar directed. All other exposures and apertures will then be lined up opposite each other on the first and second ring. The four available basic observation-time figures are distinguished on the second or time ring by a diamond for easier placement.

Never point to the source of light, but only to the objects which you intend to photograph. If necessary, make readings from close proximity, bringing the important section alone into the range of the instrument, neglecting the unimportant and incidental background, etc., although it may appear in the picture. Under brilliant white or bluish light, arc light, Kliegl Lights, Cooper Hewitt Light, time and make the exposure as you would in daylight. The actinic value of these lights is well within the practical latitude of the exposure-meter.

The exposure-meters are not designed to permit the making of two separate determinations upon one and the same object with the instrument changed from one setting to the next, for instance, from the 1/5 setting to the 4 setting. Between the different settings allowance has to be made for the accommodation of the eye to varying intensities of light. If a measurement *can* be made with the instrument in the 1/25 position, the reading must be taken at the 1/25 setting and not at the 1/5 setting. The instrument should not be altered to the next larger time figure unless it remains invisible or becomes visible only at the full aperture of the diaphragm, *i. e.,* at the f 4.5 or 4.

Movie cameras have a conventionally fixed speed. The normal and usual frequency of exposure is 16 frames per second, both for recording and projection. The average opening in the circular shutter-disc is about a half sector or 180 degrees. Each of the 16 individual frames receives, therefore, an exposure of about 1/32 second. For practical work and more convenient comparison with the conventional stop numbers, this may be rounded out to 1/35 second.

The time fraction 1/35 on the second ring is distinguished by a very prominent black arrowhead.

Set the iris diaphragm on the motion picture camera to

correspond with the same stop number to which the arrowhead of 1/35 directs on the first or stop ring of the Cinophot.

This is, then, the proper lens aperture for correct exposure at normal frequency of 16 frames per second and on regular ciné film.

It is entirely practical to use the Cinophot in this manner for all usual movie camera models. The theoretical exposure speed may be from 1/25 to 1/50, yet the Cinophot marking at 1/35 *is a practicable average* and the exposure difference is easily absorbed by the latitude of the film emulsion.

For more fastidious discrimination, the following applies:

OPEN SHUTTER SECTOR:	EXPOSURE AT 16 FRAMES PER SEC.:	LIKE CAMERA MODEL:	APPLY LENS APERTURE CORRESPONDING TO:
Over 200 degrees	1/20 to 1/30 Sec.	Victor and Filmo Cameras	1/25
About 180 degrees	1/30 to 1/40 Sec.	Ciné Kodak, Filmo Three Speed, De Vry	1/35

This shows that, for instance, users of Filmo and Victor cameras may read the Cinophot with 1/25 in position within the instrument, and set their lens diaphragm directly to the stop number indicated by the Cinophot iris diaphragm pointer. Such users need not manipulate the second ring, unless poorer illumination causes them to use 1/5, or even 4, within the Cinophot.

Ciné-Kodak, DeVry or Filmo Three Speed camera users will place the second ring as instructed and read their lens aperture below the prominent arrowhead mark of 1/35.

For use with cameras permitting a variable angle of the open shutter sector, refer to the third or sector ring of the Cinophot.

Below each group of degrees appears the corresponding

exposure time; for instance, an opening of from 50 to 60 degrees allows to each of the normal 16 frames per second an exposure of 1/100 second.

Note on this third ring the time corresponding to the angle used. The correct lens aperture for this angle will be found on the first ring, opposite this same time number,

Most amateur cameras have, however, fixed shutter sectors.

EXAMPLE: Suppose that the number 1/5 has been seen through the Cinophot and that at the proper moment the pointer has pointed to f 11.3. Place 1/5 on the second ring opposite 11.3 on the silvered part of the first or stop ring.

It is now required, let us suppose, to use an angle of 60 degrees. On the third or sector ring "50 to 60 degrees" is associated with the number 1/100.

The correct lens aperture for the angle of 60 degrees, then, will be found on the first ring, opposite 1/100 of the second ring—namely, f 2.8, as illustrated in figure 4.

VARIABLE FREQUENCY

Many motion picture cameras permit a lesser or greater frequency than the normal speed of 16 frames per second.

A smaller number of frames per second causes a proportionately longer exposure and requires, therefore, a smaller lens aperture. If the speed is reduced to 8 frames per second, each one receives twice the normal exposure.

A greater number of frames per second causes shorter exposure and requires a greater lens aperture. If the speed is accelerated to 32 frames per second, each receives only half the normal exposure.

Such alterations of the speed are best allowed for on the first or stop ring.

The following table shows the relation to normal frequency, which is 16 frames or exposures per second; "Increase" refers to larger lens diaphragm opening (numerically smaller stop number) and "Decrease" refers to smaller opening (numerically larger stop number):

SPEED TABLE

No. of Exp. per Second	Relative Exposure	Lens Aperture Stop Points: Increase	Lens Aperture Stop Points: Decrease	Generally Ciné Kodak Eyemo	Filmo and Victor	Filmo Three Speed	DeVry	Example
				Use Stop Corresponding to:				
8	2	—	—	1/16	1/10	—	—	*f*16
12	1½	—	1/2	1/25	—	1/25	1/25	between 11.3 and 16
16	**1**	**—**	**—**	**1/35**	**1/25**	**1/35**	**1/35**	***f*11.3**
24	3/4	1/2	—	1/50	—	1/50	1/50	between 11.3 and 8
32	1/2	1	—	1/75	—	—	—	*f*8
64	1/4	2	—	1/150	—	—	—	*f*5.6
128	1/8	3	—	1/300	—	—	—	*f*4

(Courtesy Drem Products Corp.)

New exposure meters are being brought out constantly, some of them are good, others last but a season and are discarded because of unreliability. However, the meters which have been discussed here are representative of the various types and each one described can be thoroughly recommended.

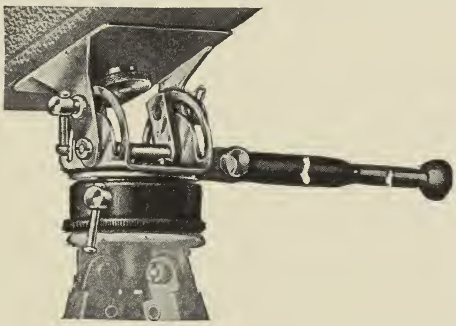
Camera Angle.—Having determined the exposure to be given, the next thing to do is to determine the camera angle. This is really nothing more than composing the stationary elements of the scene in their most pleasing relations to each other. When this is done, the action may be arranged to correspond with this set-up. As the action is under the director's control it need not enter too greatly into the actual camera angle, although of course the general locale must be suited to the action. Of far more importance in connection with the set-up is the direction of the light. We have seen that the character of the light exerts a tremendous influence upon the exposure, and now we find that the direction from which it falls upon the subject is of paramount importance.

This point, however, goes into the consideration of exterior lighting, which subject we shall have to leave for a later chapter.

Tripod.—In setting up the camera for amateur photo-

plays and family records it is better to use a tripod. This is done not only to secure more steadiness in the film, but it keeps the camera in a fixed position which will give a better screen effect in photo-plays and it enables the cinematographer to leave his camera for short periods with the assurance that he can return to it and resume exposure without having changed the camera angle. It is admitted by the most expert operators of automatic cameras that, while the camera can be held in the hands when necessary, more satisfactory screen results will be secured when the tripod is used. The more inexpert the operator the truer this statement will be.

When setting up, whether with a tripod or without, be sure that the camera is level. Remember that a camera held at an angle will give a picture upon the screen which "runs downhill" in one direction or the other, and as we do not wish to give our friends reason to question our sobriety, it is essential that we secure a levelled picture by holding the camera level at the time of exposure.



(Courtesy Burleigh Brooks)

Various types of adjustable tripod heads are in use. Those which have the lock placed to give rigidity such as the Triax head here illustrated, are recommended.

The motion picture camera, with one or two exceptions in the strictly professional models, have no rising and falling fronts. Perhaps the reason for this is that the motion picture camera reached its present high stage of development as a result of the demand for a camera which would best serve to record photo-plays. As such, its use would be principally that of photographing people and their activities. In such cases, the distortion due to tip-

ping the camera would usually pass unnoticed. However, as the amateur cameras are designed upon the same basic principles as the professional models, we must remember that we have no rising front and so we must be very careful in tipping the camera.

The camera must be held vertically. The picture at the left shows the result when the camera is held properly while the one at the right shows the effect of pointing the camera upward.

TILT.—The camera may be tipped or tilted when it is kept perfectly level sidewise, and when no rectangular objects of strong interest are included in the picture. Thus we can shoot from a window, pointing the camera downward at an angle at children playing in the yard outside and below the window's level. On the contrary, if we take a shot of a skyscraper, tilting the camera to secure the top of the building, we shall get the impression that the building is falling over backward. There is one exception to this, however. If we make a straight shot at the entrance or other ground level portion of the building, and then panoram vertically to finally show the top of the building, we get a violent distortion as the top of the building comes into view, but this distortion is quite acceptable to the eye, for, due to the motion, we get the impression that we are looking upward and the convergence of the lines of the building correspond closely to the natural perspective as seen by the eye. If you cannot get far enough away from a building to get all of it you want by holding the camera

level, move nearer to it and panoram up the side, you will get a more satisfactory effect than by tipping the camera and securing a motionless picture of the subject.

There are, on the contrary, many times when very interesting effects may be secured by the use of an unusual camera angle, such as making shots of boats from bridges, shots looking down into excavations and similar work.

Focussing.—When the camera is set in the angle it is to occupy during the actual exposure, the lens must be set to the proper focus. This is something which is evidently confusing to almost every amateur, and to some professionals as well. In the first place, by focussing we mean that we adjust the distance between the lens and the film to that point where the image of the subject being photographed is sharply defined upon the film.

> There is but one such distance for any given corresponding distance of the subject from the lens. Likewise when a lens is sharply focussed, there is nothing else sharply focussed except those objects which lie at just the same distance from the lens as the object focussed upon. Personal experience indicates that the foregoing statement is not true, so an explanation is necessary. When the lens is sharply focussed upon any given object, other objects nearer to the camera and farther away are focussed with sufficient sharpness to give an acceptably sharp image. This latitude gained through compromise is known as the depth of focus of the lens. It is known to opticians that the shorter the focal length of any lens, the greater the relative depth of focus. Therefore we find that with the extremely short focus lenses used in amateur cinematography, this tolerance is so great that objects from ten or fifteen feet to infinity are rendered with passable sharpness. For this reason, the lens can be permanently set in the camera to give this effect. We then have what is known as a lens of fixed or universal focus.

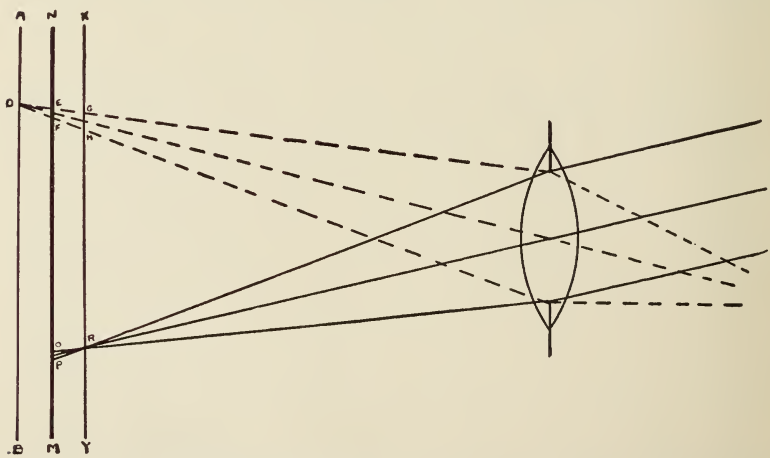
The universal focus lens is an ordinary lens focussed in such a manner as to take the fullest advantage of the tolerance just described. Such a lens equipment is always inferior to that having an adjustable focussing device.

The fixed focus lens is very convenient for rapid work, as the time usually consumed in focussing is saved, but any focussing lens may be used as a fixed focus lens by setting the focussing mount to the hyperfocal distance of the lens and stop used. (For hyperfocal reference tables, see appendix.)

Hyperfocal Distance.—For ordinary amateur work where we may tolerate a circle of confusion of 0.05 millimeter or 1/500 inch, the distance known as the hyperfocal distance may be taken as being fifteen feet. Then everything from seven and one-half feet on will be sharp to a satisfactory degree. This calculation is based upon a 25 millimeter lens working at f 3.5.

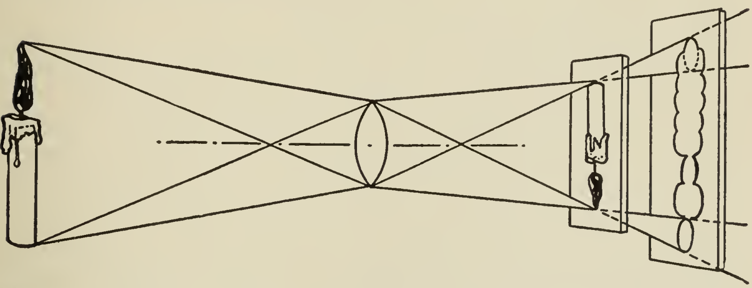
For those who are scientifically inclined, an explanation of this calculation may be of interest. Those who are not may skip this bit of technical discussion and go on to more practical aspects of the work.

Circle of Confusion.—First of all we must understand the circle of confusion. The light which we use



Here we have a lens through which two beams of light are passing. The beam shown in solid lines is emitted from an object at an infinitely great distance from the lens while the broken lines show the path of a beam from a nearby object. Behind the lens we have three planes. The first plane XY is the plane of principal focus in which the beam from the distant object comes to a focus. Plane MN is the plane in which the film lies while plane AB is the plane in which the beam from the nearby object comes to a focus. A point in the nearby object is represented by a circle (GH) in the plane XY, and by the circle (EF) in plane MN. It is reproduced as a true point only in plane AB. The beam from the distant object comes to a focus and forms a point only in plane XY. It then diverges and forms circle (OP) upon plane MN. If the circle EF and OP are not larger than 1/500 of one inch we will have satisfactory definition for all objects both near and distant. If they are much larger than this we will get a soft or even a "fuzzy" effect upon the screen. These circles, EF, GH and OP are known as "Circles of Confusion."

in photography enters through the entire aperture of the lens, each ray completely filling the lens. This ray is then condensed by the lens in a long point, like the point of a pencil. At the extreme point we find that this ray affects the film in just one point. But if we move the film backward or forward past this point, we find that this ray which bears the image of a point, affects the film over a small circle whose diameter depends upon the distance of the film from the place where the ray came to a point of "focus." When this happens in actual work we get a blurred picture because each point in the picture is represented as a small circle, and as these circles all overlap, we get the hazy confusion common in the out of focus picture. These are known as circles of confusion.



The blurred image behind the sharp one shows graphically the result of circles of confusion which are too large.

It is evident that these circles of confusion are not objectionable until they have passed a definite limit in size. This size depends upon the purpose for which the photograph is intended. For contact prints these circles may reach a diameter of .01 inch. For negatives to be enlarged in the usual manner, we have a tolerance of .004 inch, but for motion picture work we should keep these circles within a limit of .002 of one inch or approximately .05 millimeter.

It is understood then that when we have established the point of correct focus, we may move the film or the lens, in either direction, depending upon which is movable, such a distance that the circles of confusion in the images of those objects which we wish to reproduce, shall not exceed .05 millimeter.

Just how is this distance determined, and what effect

does it have upon the distance of objects focussed upon?

There is a definite relation between the distance of an object from the lens and the distance of the lens from the film.* Thus, let us first establish our true focal plane. This is a plane in which the image of the sun will be sharply focussed. In practical work any far distant object may be used instead of the sun. If we focus upon an object whose distance from the camera is one thousand focal lengths away, we find that we have to increase the distance between the lens and the film by one one-thousandth of a focal length to bring this second object into sharp focus. An object at one hundred focal lengths distance will be focussed in a plane which lies one one-hundredth of a focal length behind the true focal plane and so forth.

We are using a lens of 25 millimeters focal length and an effective aperture of f 3.5. Now as the effective diameter of the lens is 1/3.5 of the focal length we find that the convergence of the outer pencils of light amounts to 1/3.5 millimeter for each millimeter of lineal distance. This amounts to approximately .2857 millimeter. As we have established the permissible diameter of the circle of confusion as .05 millimeter, we have to determine the extreme distance at which we may place the second focal plane so that with a divergence of .2857 millimeter per lineal millimeter, our circle or section of the light cone, will not exceed this diameter.

It is easily determined that if each lineal millimeter gives us a divergence of .2857 millimeter, then each 0.1 lineal millimeter will give us a divergence of .02857 millimeter. Then we find that a divergence of .05 millimeter corresponds to a lineal measurement of 0.175 millimeter.

We therefore have a tolerance of 0.175 millimeter in the movement of the lens toward or away from the film. As our focal length is 25 millimeters, this amounts to approximately 1/143 of a focal length. Then it is evident that if we focus upon an object 143 focal lengths away, or 3.575 meters ($11\frac{3}{4}$ feet) we know from our calculations that objects at infinity are rendered with a circle of confusion not in excess of .05 millimeter.

* See "Conjugate Foci" in Appendix.

But we also have a tolerance in the other direction, of equal magnitude. This means a distance from the true focal plane of 2/143rds of a focal length and a corresponding object distance of 143/2 focal lengths or slightly under six feet. So we find that while our actual hyperfocal distance for the 25 millimeter lens, at f 3.5 for confusion of .05 mm., is 11¾ feet, we add a margin of safety and call it fifteen feet, which means that when the lens is set at 15 feet, all objects from 7½ feet on will be in focus.

The fixed focus lens is set so that it is focussed for the hyperfocal distance. We have just seen how the same effect may be secured by the focussing lens. Now let us consider further advantages of both types. The fixed focus lens gives us an image of objects at infinity which is rendered by circles of confusion of the largest permissible diameter. This means that objects on the horizon will be rendered in a very slightly hazy or "soft" manner. This is desirable in most instances as it helps in giving the appearance of depth and distance. But in cases where detail and definition is wanted in objects at a distance, we must use the focussing type of lens. Remember, too, that the apparent softness of the image increases with the size of the projected image.

On the contrary, when we wish to photograph close-ups, a very common procedure, we must use auxiliary lenses with the fixed focus lens, but with the focussing lens we focus directly upon our subject. This is a decided advantage for rarely have the auxiliary lenses the quality necessary for motion picture work, and an auxiliary of poor quality will ruin the definition of the finest anastigmat.

In view of these facts, one might well wonder why the fixed focus lens is ever used. In fact advanced amateurs really cannot understand this, but the reason is simple. In the first place, the fixed focus lens is considerably cheaper to manufacture as the focussing mount must be accurately made and is therefore an expensive item. But this is a minor reason.

The average beginner has a very vague idea of the dis-

tance of objects. He will set the lens for six feet and try to photograph an object ten feet away, and he will then blame the camera when the film comes out blurred. The manufacturers have been forced to adopt the fixed focus lens to protect themselves from the charges of amateurs who are unable to judge distance accurately. If a lens is focussed at six feet, be sure that your subject is six feet away. Remember that when you are close to your subject you have not the tolerance of focus you have when photographing distant scenes. While your lens set at 15 feet will give you everything from 7½ feet to infinity fairly sharp, when set at three feet, this tolerance or "depth of focus" is only a few inches. (For depth of focus tables and hyperfocal tables, see Appendix.)

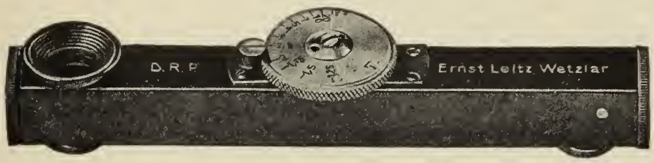
There are professional cinematographers who can judge distances to within limits of an inch or so, but for the amateur there are just two ways to do this. The first is to secure a tapeline or ruler and proceed to measure the distance. The lens is then focussed to this distance. This is a sure way but so tedious and troublesome that many amateurs prefer to guess at the distance and to trust to luck.

Distance Meters.—The other way is to use the range finder. In motion picture work where accurate distance judgment is so necessary it is difficult to understand why more of these instruments are not in use. The range finder is positively an indispensable part of the equipment of the motion picture amateur—or professional for that matter. These instruments will save their cost almost immediately, for a couple of spools of film ruined through being out of focus and more than the price of a fine range finder is lost.

There are two types of range finder on the market now which are absolutely dependable, each reading to fractions of a foot. These range finders are the Leitz "Fodis" and the Zeiss-Ikon "Goerz."

The Fodis is a small, black enamelled instrument, 7/16 inch square and 4⅛ inches long. It has a nickel plated dial in the center of one side engraved with the various distances, from 3 to 100 feet. At one end of the square tube, on the same side as the dial is an eye cup. The meter is either held in the hand or attached to a clamp fastened to

the camera in such a position that in looking through the eyepiece the subject which is being photographed, can be seen. In doing this care must be taken not to obscure either of the base windows which are located on the opposite side of the tube from the dial and eye-cup and at the two ends of the tube. The object can be seen when one window is covered, but if both are unobscured, the object will be seen as though looking at it through a yellow screen. In the middle of this yellow field there is a colorless circle of



(*Courtesy E. Leitz, Inc.*)
A range finder is an indispensable item in the equipment of any ciné amateur. The Fodis illustrated here may be secured with a special holder which may be attached permanently to the camera.

much smaller diameter. In this inner circle, the details of the subject will be displaced in relation to that portion seen through the yellow field. The dial of the instrument is now turned until the details in both colorless and yellow portions of the field exactly coincide. The dial will now indicate the distance of that particular subject, and you may depend upon the reading being absolutely accurate. The lens is now set for the distance indicated by the distance meter and the photographic work carried on. This meter is a small reproduction of the large industrial and military range finders made by the same firm, and it is made with the same exquisite precision which characterize the larger instruments.

The other distance meter, the Zeiss-Ikon Goerz, is of somewhat different dimensions. It measures 5/8 x 15/16 x 3 5/8 inches. It has an eyecup at one end of one narrow side and a dial at the other end of the same side. The base windows are of rectangular shape, one larger than the other, and located at the ends of the side opposite the dial and eye cup. The instrument is finished in crystal black enamel, the dial being finished in polished black enamel engraved in silver. It reads from four feet to one hundred

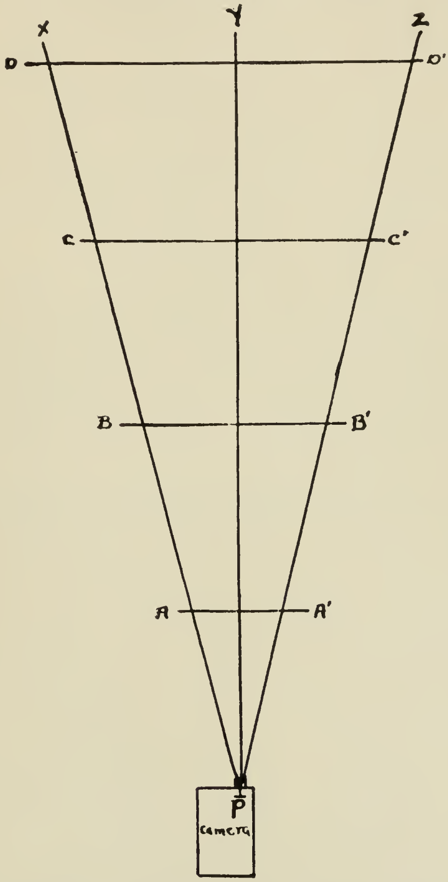
feet. (It is understood that in all amateur motion picture work, one hundred feet and infinity require coincidental settings.)

In this meter the image is divided into two distinct portions. The upper portion appears as a long rectangle, and in this the upper portion of the image appears. Below this is a square with its upper side coinciding with the central portion of the lower side of the upper rectangle. In looking at the image of the subject, the lower portion will be seen to be displaced laterally. The dial is turned until both portions of the image coincide and are brought into proper relationship. The dial now indicates the distance of the subject. This meter is also absolutely reliable, as might be expected of any optical product of Zeiss-Ikon.

In both meters the measurement is brought about by bringing into coincidence the displaced portions of one image, both have a delicate dial adjustment, both are reliable, and both made in the manner in which scientific instruments should be made, yet both are remarkably inexpensive. The writer has had the opportunity of using both of these instruments and he can say definitely that both give absolute satisfaction in every way. Moreover, even an experienced photographer, after using one of these meters for a short time will not consider being without one, for a measurement can be made in less time than is usually consumed in mentally estimating the distance of an object, and the result is known to be absolutely correct.

Visual Focussing.—There are times, however, when the only satisfactory arrangement is a direct visual focussing device. In cases where the exact arrangement of the subject must be secured by direct vision, coincident with focussing, there are only two devices available. These are the reflecting focussing device and the sliding base focussing device, both Goerz products. The reflecting focusser is a "T" shaped device. A short barrel of a size which screws into the lens socket of the Filmo and Victor cameras. From the side of this barrel extends a smaller tube which in turn has a sliding button extending through the side. This smaller tube is a compound microscope which may be accurately focussed upon the focussing

screen. This screen is so placed that it will be exactly the same distance from the lens that the film surface is, but at right angles to the principal optical axis of the lens used.



The Camera Angle. Here we have the camera with the lens at point "P." The lines PX and PZ are the "Sidelines" while the line PY is the axial line of the optical system and the center line of the field. It is evident that the field AA′ although only one-fourth as wide as the field DD′, will fill the same film area. Thus nearby objects are represented in large size and more nearly fill the frame than objects farther away.

A total reflection prism is placed at the junction of the tubes whose position is controlled by the button extending through the side of the tube. When this button is pushed away from the eyepiece the prism is placed in the path of the rays entering the lens and forms an image upon the visual screen just as the image is secured in a reflecting

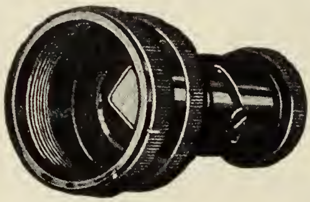
camera. When the button is pulled toward the eyepiece the prism is removed from the path of the light rays and the full amount of the rays fall upon the film. Thus we have a reflecting focussing device which entails absolutely no loss of light. In addition this device with the normal extension adapter supplied with each lens affords a lens extension which makes possible the photography of objects lying only about four or five focal lengths distant from the camera. This is a point of very considerable value and one which will be discussed more fully in a later chapter.

Sliding Base.—The sliding base device is somewhat more elaborate, but perhaps the most versatile device yet designed for substandard use. The principle involved is similar to that used in the finest studio cameras. Briefly the device consists of two parts which move in relation to each other. One of these is a base, the front of which carries the mask box and sun-shade. Upon this is mounted a sliding piece to which the camera itself is secured. By the side of the camera a focussing microscope is mounted. This device is set upon a tripod, and the camera moved to the right of the base. This brings the focussing microscope into line behind the mask box. The picture is composed and the lens focussed by means of this microscope. When this is done the handle is moved and the camera pushed to the left side of the base. This brings the camera lens into position behind the mask box in just the position occupied by the lens of the focussing microscope. The picture is now made with full assurance that the scene depicted upon the film will be just exactly as desired. As has been mentioned this is the method used by professionals and is perhaps the most perfect visual focussing system yet devised for focussing the motion picture camera.

Focussing Microscope.—There is one other method of focussing. This is by means of the focussing microscope as supplied with the Bell & Howell Filmo. This is a little device equipped with a ground glass screen and a magnifying optical system. It is so arranged that the lens may be removed from the Filmo and inserted in the barrel of the device. If this is now held so that the lens is in approximately the same position it will occupy when on the

1. A typical amateur camera outfit including Victor camera, Goerz telephoto lens, reflecting focusser, sliding base, mask box, outside iris and title devices, Cinophot, Tenax meter and Leica camera for stills with the Fodis range finder attached.
2. The projector outfit consisting of DeVry projector, Prismo screen and Kodak rewind.

camera, and the focussing mount turned until the image is clearly seen, the lens may be removed, replaced upon the camera and the exposure made with confidence that the image upon the film will be just as accurately focussed as the image which was seen in the microscope. This method of focussing depends upon the personal equation as does all visual focussing. If you possess the ability to correctly focus a photographic lens visually, you can secure dependable results, and any failures met with will be a result of personal error and will not be the fault of the instrument. This device supplies the place of a visual focussing arrangement.



(*Courtesy Bell & Howell*)

The focussing microscope. This is a device designed for use with the Filmo camera which enables the lens to be focussed visually by removing it from the camera and inserting it in the focussing microscope.

Thus we see how the gravest objection to the focussing lens can be overcome. Let us then examine the advantages of this lens. First, and most important, we can focus upon any object within range of the focussing mount, knowing that we have secured a definition in which the diffusion due to the circle of confusion is little if any larger than the actual silver grain of the developed image. In other words we secure the finest possible degree of sharpness. This means that we can use a tremendous enlargement in projection. The possibilities of projection from an accurately focussed negative was demonstrated to the writer recently, when an ordinary 16 millimeter film was projected in a new projector, soon to be introduced upon the market, upon a screen 6½ x 9 feet with a quality fully as good as any theatrical projection. One scene was from an agricultural film, showing a prize-winning hog. The individual bristles were plainly visible upon the screen despite the approximate enlargement of 270 diameters, the equivalent

of standard projection 22½ feet wide. The projector throw was approximately 30 feet.

It would have been practically impossible to duplicate this performance using a film made with a fixed focus lens.

Also, with the focussing lens we may take advantage of differential focussing, which is a subject of the greatest importance in securing pictorial effects. By focussing on the closest possible portion of our subject, we are able to throw the distant background greatly out of focus. This prevents the background from becoming obtrusive, it prevents objects in the background from distracting the attention of those who view the film and in this manner concentrates the attention upon the principal subject. In addition, it adds considerably to the purely pictorial effect of the subject.

In the case of objects at a distance, we must use a lens of longer focal length than normal. This subject will be discussed in detail in a later portion of the book, but at present we will notice that the fixed focus lens is practically always built as an integral part of the camera and does not permit interchange with other lenses. No motion picture camera outfit can be considered to be complete until it is equipped with a full battery of lenses, including one of five and one-half or six inches focal length. This means that the full battery must be mounted in focussing mounts.

In short, the only lens to be considered by the serious amateur is one which is mounted in a finely calibrated focussing mount.

With the camera set up, then, you determine the distance of the subject, or the central portion of the space in which the action will take place, and set the focussing mount of the lens to correspond with this distance. This procedure will be followed by owners of the new Victor camera, the latest model Ciné-Kodak B, the Bell & Howell Filmo, the DeVry, the Ciné-Geyer and other similar instruments.

All is ready now to make the exposure providing the lighting is right, but as this is a subject which must be dealt with at some length, we will assume that it is correct. The release is pressed and the camera allowed to run

for a sufficient length of time to record the desired action. Try to keep this under thirty seconds and more than ten seconds. If any interruption or bad mistake on the part of an actor occurs, stop the camera, call "Cut," which will inform the actors that the camera is stopped, as will be explained in the chapter devoted to direction. A small slate is held up in front of the camera bearing the letters "NG" (No good), and the scene started again. If the scene progresses as it should and terminates normally, the slate is photographed bearing the number of the scene as will be explained later.

Pam.—Occasions will arise when it will be desirable to move the camera during exposure. This movement, usually a lateral one, is known as the panorama or more commonly the "pam." This movement may be either rapid or slow. The slow pam is made to show consecutively different portions of any given object. The rapid pam is used in following a rapidly moving object, keeping it in the center of the field.

The slow pam must be made very slowly, and no camera motion should be allowed except the lateral one. Any up and down motion will give a most unpleasant screen dance. At the most, any given object should be allowed at least six seconds to cross the screen in a slow pam. This effect is secured at its best with the aid of a tripod having a panoramic head. This may have a friction device which aids in securing a uniform motion, it may be operated through gears by means of a crank which also gives a slow, uniform motion, or it may be an automatic head such as is made for the Filmo camera which operates through the medium of the camera spring and makes the panoramic exposure entirely by automatic means.

At no time in a slow pam should the motion be so rapid that any blurring is noticeable.

The rapid pam is an entirely different form of motion picture. In this we have a subject moving very rapidly, such as a horse running. These pams must be made with the camera held freely in the hands. You will probably not secure a good result with the first one or two of these which you try, for there is one thing which is imperative. The

projected film must show the subject in a fixed position with regard to the edges of the frame. If the subject advances so that it nearly runs out of the frame and then drops backward until it almost drops out of the frame, then rises and falls, the result will be very annoying to spectators. Remember that in this work you are imitating the effect we secure when we follow, with our eyes a similar rapidly moving object. In this case the background is neglected, and allowed to blur, in fact the greater the blurring due to this motion of the camera, the greater will be the effect of speed. Moreover if this blurring is so considerable that all vestige of detail is lost the effect upon the eye will not be as tiresome as when there is a vaguely defined detail which the eye tries to catch. In actual life, when you are watching a race, you unconsciously ignore the background, so in the rapid pam you want to make this background as formless and unobtrusive as possible.

Tripods.—There are many forms of tripods on the market suitable for use with amateur motion picture cameras. As far as the actual tripod is concerned, that is the three legs and the solid top, almost any type will serve, the more rigid the better. In fact, there are few types of stand which will prove as useful as the light weight home portrait stand made by various manufacturers of photographic supplies. One of these equipped with an extensible member which will permit the use of the tripod outdoors upon uneven ground is the best. These extensible members are equipped with steel spurs which prevent slipping. For indoor use they telescope into the main leg and the spurs are protected. The stand may then be used upon the most highly finished floors. Due to their construction, the legs cannot slip, allowing the stand to fall over. The legs may be clamped in any position, while a center post which bears the camera plate may be raised and lowered within quite large limits. Then too, these stands have a double head which is designed so that the camera may be tilted at any desired angle up to 90 degrees. By reversing the camera upon this head, this full tilt may be utilized in either direction.

There are also numerous telescopic metal tripods offered. Some of these are excellent and others are worthless. The tripods of the Triax type, which fold rather than telescope, which are made of the new aluminum alloy enabling them to support from 60 to 70 pounds dead weight, which unfold ready for use by pressure upon a button and which lock in both open and closed positions are the most satisfactory light tripods. The writer has used one of these light tripods with a 16 millimeter camera with complete satisfaction. As the weight is less than two pounds and the closed length about sixteen inches, the tripod is convenient to carry when a larger and heavier tripod would be left at home. There is sufficient rigidity for the automatic camera to be operated correctly.

There are also a number of "walking stick" tripods. Some of these have a light duralumin tripod concealed within the bamboo body of the stick itself, others are made in which the stick itself splits into three 120 degree legs with one telescopic draw. These novelties are convenient, but hardly rigid enough to be fully satisfactory, although by steadying them with the hand they will serve in an emergency and they are of course very convenient to carry.

The cheap metal tripods whether folding or telescopic should be avoided as their use will invariably result in a dancing, shaking picture upon the screen.

There are also numerous supplementary heads supplied for use with the amateur motion picture camera. There is the ACH automatic panorama head for use with the Filmo camera, giving a fully automatic panorama operated by the camera drive spring, the ACH geared panoramic head operated manually by crank, the Triax which has both tilt and panorama similar to those employed on professional tripods, the Ball head, which is a smoothly polished steel ball upon which the camera plate rests, permitting motion in any direction. It is operated by an extension handle, which may be moved in either horizontal or vertical directions or a combination of both. This gives a very useful control. A similar effect may be secured with the friction heads similar to the Omnia. The ball tripod head gives a direct oblique motion while the Omnia gives the

oblique by means of a combination of the vertical and horizontal movements.

The tripod selected for the camera must above all be firm and rigid. This is especially true with those cameras of advanced design which provide for both manual and automatic control. The use of the hand crank will give rise to vibration under conditions when the automatic camera would not. For use with cameras which are spring driven only, the lighter type of tripod may be used. The combination camera, can of course be used on the same type of tripod as long as it is limited to spring drive.

Any combination of tripods and heads mentioned may be used with all success, the principal thing to be remembered is that a tripod will add at least 100% to your chances of producing a good film.

There is one tripod which is quite novel and deserves special mention. This is made by the makers of the famous ACH accessories. It is known as the "table tripod." It is a small stand about ten inches in height intended to be used upon a table. It is compact and convenient for use indoors with any small table. It has a tilt head allowing the camera to be set at any desired angle. It may be of interest to know that the ACH accessories were all designed by an amateur who made the first model of each of these accessories for his own personal use. This is a radical departure from the usual one in which a professional designer produces accessories with the sole idea of sales value.

There is a little more to be said concerning the actual manipulation of the camera itself in so far as making straight shots at normal speed is concerned. Lighting, trick work, special lenses and their uses, artificial lighting, sets, acting and so forth will be taken up in their own respective chapters. There is one more subject to be covered in the present chapter, however, and that is the one which is concerned with cinematography at other than normal speed.

Camera Speed.—There exists in the minds of many people considerable confusion concerning the relation which exists between camera speed, projector speed and screen speed. Let us consider a specific example. Suppose

that we have an actor before a camera. Let him walk across the field of the lens at such a speed that he will occupy five seconds in making the passage. This means that his image will be recorded upon 80 frames of film. We know this because sixteen frames of film pass through the camera each second when the instrument is operated at normal speed. Now if we project this film through a projector which is also running at normal speed the action will be reproduced as it was in nature. The actor will cross the screen in five seconds.

Now let us operate the camera at one-fourth normal speed, or four frames per second. The entire action of crossing the field will now be recorded upon twenty frames of film (4 x 5). Now if this is projected in a projector running at normal speed, these twenty frames will pass through the projector in 1¼ seconds, making the action very fast, therefore:

Running the camera at slow speed gives an exaggerated speed upon the screen.

Now let us once more take the first film made at normal speed and run it through the projector at two times normal speed, or thirty-two frames per second. We have eighty frames in all, therefore these will pass through the projector in two and one-half seconds or twice natural speed, therefore:

Increasing the projector speed increases the speed upon the screen.

Now let us take the film which we made at one-fourth normal speed and project it at one-fourth normal speed. We exposed four frames per second in the camera, and the action required five seconds for completion, giving us twenty frames exposed, as we have seen. If we project this at one-fourth normal speed, we shall project four frames per second, and the action will require five seconds screen time. In this case also we have reproduced normal motion, but we observe a painful flicker due to the slow speed, therefore:

Any picture projected at the same speed used in talking will give a natural screen speed.

Also,

Projection at a slower rate than normal gives rise to painful flickering upon the screen.

By the same line of reasoning we can see that no matter at what speed the camera is operated, a reproduction of natural motion will be secured by operating the projector at the same speed.

Slow Motion.—Now let us take the pictures at an extremely fast camera speed. Suppose we use four times normal speed, this means that sixty-four frames of film will be exposed during each second of the five second action, or a total of 320 frames in all. When we project this at normal speed, we find that these 320 frames require twenty seconds to pass through the projector, and upon the screen we have the action proceeding at just one-fourth normal speed, therefore:

The more rapidly the camera is operated the slower will be the screen speed.

This is the way in which the slow motion pictures are made which are so greatly admired by everyone.

The extremely slow motion which has been mentioned—that is an extremely slow crank speed—is inadvisable. Half speed is sometimes permissible when the light is so poor that no picture could be obtained otherwise, but aside from this the slow speeds should not be used to any great extent. One of the most common uses was that in which a traffic snarl was shown upon the screen with the various vehicles darting about at tremendous speed, and for similar comedy effects this slow crank may still be used, but for the most part, it should be avoided.

When the light is so poor that exposure is impossible at even the widest available lens opening, and where the speed of the subject is not excessive it is possible to operate at half speed in order to secure the picture, but it must be remembered that the screen speed will then be twice normal, although this can be compensated for somewhat by slowing the projector a trifle.

These are about the only conditions which warrant the use of the slow crank, but on the other side of normal speed, in the high speed camera work for making slow motion films we have an entirely new world opened before

us and one of the most pleasurable branches of cinematography made possible. It must be remembered that for true slow motion pictures, the speed of the camera must be considerably faster than normal. At the present time this speed is available in the Filmo Superspeed model, the Victor regular model, the Ciné-Kodak "A" and the DeVry special model. The Filmo is a special camera made for this purpose alone, while the Victor, Ciné-Kodak and DeVry may be adjusted for taking at either normal or superspeed. There is also a Filmo model which will take at either normal or double speed, the double speed giving a slight slow motion effect upon the screen.

It is interesting to note that of all the slow motion models, only the Ciné-Kodak is hand cranked. With this camera both slow motion and single crank are secured through attaching small gear boxes to the camera. Naturally, this gives the operator full control of speed so that, when he desires, he can vary the rate of camera operating speed. This enables him to speed up some subjects and slow down others.

A famous scientist once said that people wandered all over the world in search of the interesting and of the beautiful when there was more of each in the ordinary backyard than the average individual could see in a lifetime. This is a very true statement. The reason we do not see these things is the fact that the human sense of sight is greatly limited. We can see things which are of average size. We cannot see the very small objects and very large objects are beyond our appreciation. We can also see motion which is of average speed, or rather we can see a tiny portion of speed which is neither fast nor slow. When we know that there are movements which are measured in inches per century, and others which are measured in miles per second, we find that sight is a very deficient sense. The motion picture camera extends this sense of vision so as to embrace perhaps a thousand times as many speeds as we can observe with the unaided eye.

For example, when we see an aesthetic dance, we are pleased with the grace and rhythm, but the abstract beauty of the motions themselves is lost to us because they are

more rapid than the eye can readily follow. If we make a film of such a dance, using superspeed, we find that a world of beauty is opened to us. We find the same thing in hundreds of human activities. For instance, there are few things which possess more sheer beauty than an expert swimmer making a dive. We lose this in natural sight because of the rapidity of the fall, but slow it down four, six or eight times, and you will readily perceive the bird-like flight of the diver. This is especially true of the swan dive. Then, even in Nature, we find the same thing. I once saw a film made at high speed and a fairly long focus lens of dolphins playing off shore at a resort beach. These creatures are graceful at any time, but the film which showed them rising slowly from the water and soaring like huge birds made one of the most interesting films I ever saw.

But novelty and beauty by no means exhaust the possibilities of the slow motion film. There is nothing which can equal it in securing true comedy effects. If you want to see a film which will always raise a laugh and which will not pall as does the slapstick, make a slow motion film of a group of kittens playing. The cat is so quick in its motions that we lose the subtilties of its action, but when slowed down, these motions become most laughable, and such a film will retain its interest for an indefinite period.

In the field of sport the slow motion is of incalculable value. In the first place, slow motion films showing experts in action serve as the best instruction obtainable, being actually far superior to personal instruction. This method of instruction has already been applied to golf and slow motion films of golf experts may be purchased on the market. The superiority of this form of instruction is due to the fact that no matter how closely we may watch the swing of a professional golfer, our eye cannot actually follow the motion and we unconsciously reconstruct the entire action from observing only the beginning and the end of the swing. With the slow motion film we may carefully watch every change of position throughout the course of the swing. This principle is applicable to every form of sport known. The boxer learns how to guard by watching

the slow motion film of expert boxers. Tennis players quickly learn the proper swings. Baseball players can watch the flight of a ball, see it curve or drop slowly and actually see the meeting of the bat and ball, or the exact amount of distance between the ball and the bat in a strike.

Racing fans, whether followers of horseflesh or gasoline, know that the tricks of jockeying are so subtle that even experts often miss them, but the slow motion record will pitilessly expose all such questionable tactics, as we see the action drawn out upon the screen. But aside from this, the lover of horses should not miss the opportunity of securing at least a hundred feet of slow motion film at the next race. There are few subjects which will appear to better advantage upon the screen than a slow motion of running horses. If a steeplechase can be secured, so much the better. This brings to mind the clear, crisp days when the hounds are running. If you are lucky enough to secure a position where the hunt will pass, you will secure the film of films. First comes Reynard, trotting along apparently at ease, but the slow motion film may disclose the dragging movements of exhaustion, then come the hounds in full cry, tongues lolling as they sail through the air like monstrous bats, and then the horses and riders springing through space, with clothes floating rather than flying behind them. Remember that you have only one hundred feet of film in your camera, and that this is sufficient for only one minute at four times normal speed or for thirty seconds at eight times normal. Conserve your film, and try to get the entire hunt on the one spool, but in this case prepare to have a number of duplicates made for every member of the hunt will want a copy.

One may name through the entire list of outdoor sports and for each of them a use will suggest itself for slow motion. Then, there is the other side of this same picture. Let us again take golf as an example. Suppose that we have studied the slow motion films of more expert players. Then we have a friend make a slow motion picture of ourselves. We study that, and compare this film with the first and in this way, we at once spot the fault which is keeping our scores so high. The slow motion film serves first as

instructor and then as critic. So evident is this value, that the large Universities are using this very method for training the various teams which will represent the University in athletic events.

This would seem to exhaust the possibilities of the slow motion, but many amateurs who have introduced their cameras into their business routine have found that by making slow motion films of various commercial operations, unnecessary motions are clearly revealed and that any ordinary business executive can go into the production department and beat the efficiency engineer at his own work. In short one may truthfully say that the slow motion camera extends our field of vision to such an extent that our familiar world is lost and we find three new things of interest for each familiar phase of life.

The use of the slow motion camera requires some care, of course. In the first place the mechanism is necessarily more easily injured, for it works under a tremendous strain. Without investigating the exact measurements it may be safely assumed that an intermittent mechanism working at eight times normal speed is operating under a mechanical strain about one hundred times as great as that encountered at normal speed, for mechanical strain advances out of all proportion to absolute speed when operating at extremely high speeds. Remember that at eight times normal, the film is exposed at the rate of 128 exposures per second, that the film must be started, advanced and brought to a dead stop in a period of time only 1/256th of one second in duration, and that the film is both stopped and started 7,680 times every minute. At the same time, the practical limits of size and weight limit the bulk and therefore the mechanical strength of the mechanism, and finally this mechanism must continue to operate for long periods with an accuracy of plus or minus one one-thousandth of one inch. Therefore, the slow motion camera must receive the best of care if it is to remain in a satisfactory working condition.

In threading be absolutely sure that the film fits snugly about the sprocket, and that the teeth engage the perforations exactly. Watch the loops carefully, be sure that they

are neither too small nor too large. Run at least six inches of film or stock through the mechanism at normal speed to make sure that the film feed is working properly, and finally see that no dust, grit, film particles or other foreign matter is in the camera chamber.

In making the exposure, calculate the exposure (i.e., the diaphragm stop) as usual, then increase the stop proportionately. Thus if the meter indicates stop f 16 and you are using four times normal speed, you would use f 8 and for eight times normal speed you would use f 5.6, because the lens stop values vary, not in direct proportion, but as their squares. Thus $(5.6)^2$ equals 31.36 or for our purposes 32, $(8)^2$ equals 64 and $(16)^2$ equals 256. Thus we see that the figures 32, 64 and 128 have the relative values of ⅛, ¼ and 1. Or expressed in exposure values they run 8, 4 and 1 corresponding to our shutter speeds of normal, four times normal and eight times normal.

As we have to use a larger lens opening with the high speed camera than we would otherwise, we are forced to observe two points. First, we cannot use the high speed camera unless there is an abundance of good light, or unless we make use of an extreme wide aperture lens such as the f 2 or the f 1.5. In fact the latter (the f 1.5) is exceptionally well adapted to this work as it is more than five times as fast as the f 3.5, which means that we can make four times normal speed film in a light which would be insufficient for normal speed film with the usual f 3.5 lens. The f 2 lens is more than three times as fast as the f 3.5.

The second point to be remembered is that as we increase the lens aperture we must take more and more care with focussing, so that when we reach the largest aperture we must focus exactly or risk losing the film. Here we find that the range finder or distance meter has ceased to be a very convenient accessory and has become an absolute necessity.

Finally, remember to keep the camera scrupulously clean at all times. Brush it out with a soft camel's hair brush, and make sure that there is no dust or grit in the corners. This will not only cause the bearings to wear, but it will also scratch the film.

At times grit or dust, or perhaps a gummy deposit from the emulsion will accumulate in the gate causing scratched film and causing the film to "chatter" or stick in the gate. The gate must be kept thoroughly clean. Wipe it with a soft cloth, and if any of the emulsion deposit is seen, remove it with a horn palette knife or similar instrument. Never clean the gate with any iron or steel instrument as you will be sure to make tiny scratches which act as chisels and aggravate the trouble. Do not oil the gate and do not use alcohol or other solvents in cleaning the camera. When the gate has been scraped with a soft instrument, the final particles of emulsion may be removed by gently rubbing the aperture plate with a moist cloth.

Do not expose the camera or lens to direct sunlight except when it is in use. Do not let it lay around where the sun will fall upon it, especially in hot weather. A hot camera will almost always result in buckled film and other similar troubles.

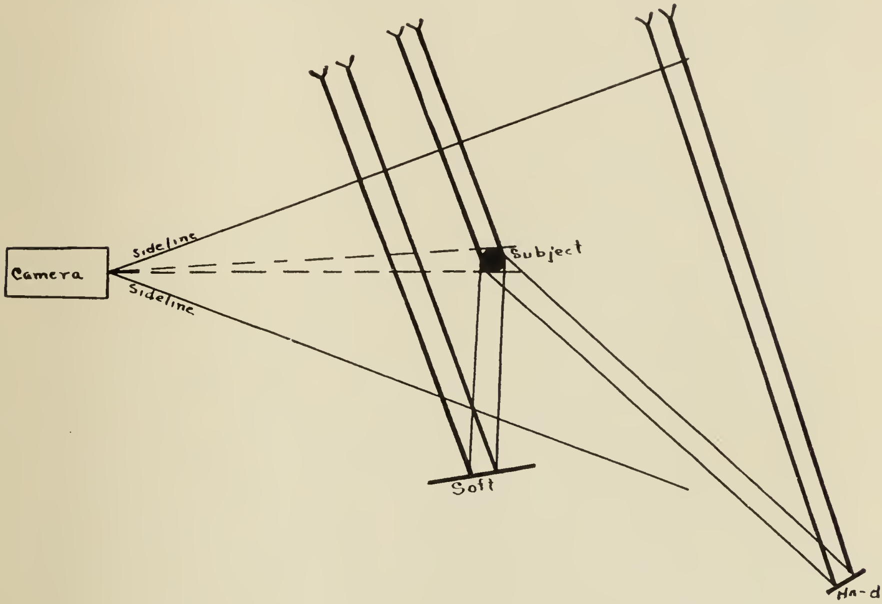
CHAPTER FOUR

EXTERIOR LIGHTING

We have already considered lighting in reference to its chemical effect upon the sensitive emulsion, but it has another purpose almost as important. This is its power of making objects visible in their complete physical form. For example we have light, formless and without physical structure of any kind. This is light in the abstract, the light which comes from the sun or other source and which affects the sensitive chemicals which go to make up the emulsion used in photography. This light has one peculiar characteristic which makes possible both sight and photography. Light travels in a path which may be regarded as a perfectly straight line. This is not strictly true, but for our purposes we may regard it as being so. The only exception which we will consider is that the light ray is bent at an angle when passing through certain transparent substances. Also, when the ray strikes an opaque object a certain proportion of the light is sent back or reflected by that object. The amount of light, the individual portions of the ray which are reflected determine the color and tone of that object. And finally the reflected ray leaves the surface of the object at an angle equal to that at which the original ray struck the object, but in an opposite direction. Due to this fact, that light is reflected and re-reflected from all objects, we soon have the enormous, the infinite number of rays crossing each other at all directions which provides us with "daylight," the light which enables us to see objects which are protected from the direct rays of the sun.

Direction of Light Fall.—As some light is falling upon any given object from almost every conceivable direction, it follows that light is also being reflected from

that object in every conceivable direction, but we must remember that any given ray reflected from that body travels in a straight line.



Exterior lighting. This shows how the light falls from the left and from the rear of the camera upon the subject. This light also falls upon a soft reflector and is reflected to illuminate the shadow side of the subject and upon a hard reflector from which it is reflected to give a backlight.

Then if we stand in such a position that we face such an object, it follows that one ray from each infinitesimal point in the surface of that body is directed through the pupil of our eye, and as the rays travel in straight lines, it follows that a tiny image of that object will be reconstructed in the eye. So we find that the straight line travel of light rays combined with the reflecting properties of all objects makes it possible for us to perceive form.

In like manner, there are certain characteristics inherent in particular substances which cause that object to reflect only certain portions of the light ray. This gives rise to color; and finally, no object will reflect all of the light which falls upon it. The extent to which the total light is reflected by any object, in any given direction determines

the visual luminosity of that object when viewed from the direction in question.

In photography we may disregard color for the time being, although it plays a very important part in monochromatic photography as we shall see later.

Our first idea is that the purpose of light is to render objects visible, but our sense of sight not only makes objects visible as masses, it indicates the shape and form of the object in full detail. This is done by our interpretation of the shadow forms upon the surface of the object. The variation of tone, of shade and the changing balance of light and shade enable us to perceive form, but when a skillful painter faithfully imitates these forms upon a flat surface, we imagine we still see the original form. Just so, a skillful photographer will record upon his plate the gradation of light and shade which makes form, three-dimensional form, quite apparent. However, the photographic film cannot reproduce the infinite variety of natural gradation, the photographic scale being compressed. Due to this fact, we must have contrast of a rather well defined nature in the original to render a fairly good photographic image. When the light falls from an improper angle the form of the object will be lost, and it is no longer familiar.

Not only is this true, but the quality of the light which falls upon the object has a great deal of influence upon its appearance. If the light is unusually hard, that is with intense light falling from a single source upon one side of the object, with sharply edged, deep shadows on the opposite sides, the relief is exaggerated and curves become angular. Such lighting gives a harsh effect. On the other hand if we have a general diffused light, not very bright, and with no decided directional effect, we have a light in which there is very little contrast. Angles become softened, with diffused edges and we have a "flat" photograph. If we have a light which is brilliant on one side, but not of maximum intensity, and if we have the shadow side illuminated by reflected light considerably less intense than the principal lighting, we will have a light which gives a flowing gradation to curved surfaces, yet which picks out

angular constructions sharply. This is a balanced light such as is proper for most work. If you have an unusually "strong" scene, a deliberately harsh light may be used to heighten the effectiveness of the scene. For example, suppose we have a criminal, stalking a victim. He lurks in the shadow of shrubbery. We illuminate his face with a concentrated spot. The features on the lighted side leap out into a practically flat glare of white, while the side opposite the light blends into the shadows of the background. This makes a very effective lighting which adds to the spirit of the scene, but such a light used to photograph the baby in the nursery would be absurd. So we see that the diffusion of the light, i. e., harsh, normal or soft, may be worked into the spirit of the scene to aid in giving the audience the proper impression. Harsh light for mystery, evil, terror. Normal light for normal, cheerful scenes and a soft light for scenes which verge upon the sentimental. Still there are exceptions. A campfire scene may be of quite a sentimental nature, yet the lighting is harsh. This is not a sympathetic light treatment, but necessitated by the scene enacted. Campfires give such light and any other would be unnatural. Likewise a furtive figure slipping away in a fog would require a flat light, for there is normally but little contrast in a fog. However, common sense will indicate when an otherwise inappropriate lighting effect should be used.

Many pictorialists in the still field advocate working in hazy light. For their purpose this is all right, but the motion picture photographer should swing back to the "Brownie" rules, bright light and lots of it. The cinematographer must not only study lighting, he must master it before working consistently with soft effects and even then he will secure these effects under a brighter light than does the pictorialist. The latter has a camera with which he may make an exposure for two, three or even more seconds. The motion camera is limited to an exposure of a fractional part of a second, usually 1/35th or less. The motion picture camera will not permit the necessary exposure for working in very hazy light, unless equipped with an extremely large aperture lens. Finally as any spirit of art

expressed in the usual motion picture is the art of the drama rather than of pictorial composition, the motion picture should be more brilliantly illuminated than the still photograph. The illumination of the motion picture more nearly approaches the lighting used with normal commercial still photographs.

You who wish to go into the art of picture work, for your own benefit, work with the brilliant lighting until you know just how to control your film, and then if you will, venture into the realm of fancy lighting—but remember, it is a difficult field. A knowledge of lighting is the knowledge which has brought to certain cinematographers salaries which rival those paid to directors and stars. At the risk of disillusionment I must add that anyone can learn to thread and crank a camera in a very short time. In fact many of the artists in this line use electrically driven cameras in the studios, but in the arrangement of the lighting effects these masters demonstrate their supremacy.

As far as direction is concerned we have six primary lights. These are: from the right; from below; from the left; from above; from the front, and from the rear. These primary directions, like primary colors should be used sparingly and for only special effects. The perfect lighting is a combination of two or more primary lights. For example the standard oblique lighting, which should be used by the amateur at the start of his work and at all times when he wants the scene depicted with no special light effects, is a combination of side, front and vertical lights. In this discussion the front and rear directions of light will be considered as from the position of the subject, not of the camera. Thus the light described will come from behind the camera, at one side and above, as is found in sunlight in mid-afternoon, with the subject facing South (in the Northern hemisphere).

If we examine a good painting, we will very probably find a small area of pure color in the composition. This area serves as an accent. If we analyse the painting we will see that this same fleck of color placed elsewhere in the picture would be a glaring defect. Such accents must be placed only after a careful study of the

composition. In the same manner we make use of spot lights to give a pronounced, but small area of pure lighting to serve as an accent, but if improperly used it will ruin the picture. Let us take full backlighting for example. In this work, i.e., lighting directly from the rear, our first care is to screen the source of light from the lens. Then we must decide just how we will arrange the effect. In consequence, we rarely use the full back-light except in close-ups and usually then only with feminine characters. By proper use we will get a soft, glowing halo about the head, but if we don't use this light properly we will no doubt get a general cloudy, foggy effect which ruins details, and which is a blood brother to the halation which is the bane of the still photographer. In fact, in usual studio practice, the backlight is a secondary light, combining the rear light with either side or vertical, and sometimes it is tertiary, combining all three directions.

It is very difficult to describe the effects of the various pure light directions, but the accompanying illustrations show this to good advantage. Further illustrations show some of the more common secondary and tertiary light directions.

Balancing Light.—In the combined forms, we encounter the problems of balancing our lights. Remember that an evenly balanced light is worse even than a pure primary light direction. This cross lighting will trip you up if you are not very careful, for our eyes are so sensitive to delicate nuances of gradation that we can see contours perfectly when the camera will register only a flat plane. The actinic value of the light reflected from the lightest parts of the bright side of the subject should be at least twice as intense as that reflected from the brightest portion of the shadow side.

This problem of balancing the light is one which has proven very difficult because it has not been clearly understood. To approach it properly we must consider just a bit of photographic technique. The sensitive material which is coated upon the celluloid film used in the camera is known as the emulsion. It is usually stated that this emulsion becomes darkened, during the various

processes of finishing, in proportion to the amount of light received. This is not true. It becomes darkened *relatively* proportionately to the amount of light received. Thus we find that a scene in nature in which the ratio of the brightest light to the darkest shadow is one to fifty thousand, our photograph will show a scale of gradation in which this ratio is perhaps one to one hundred. In other words each tone in the photograph embraces five hundred tones of the original scene, therefore, while the relative proportions are maintained, the scale is reduced to one five-hundredth. If we assign scale values to the various areas of the original scene, we may have two adjacent areas which have values of say 1,200 and 1,500. The difference is quite plain to our eye, yet as these areas only lie 300 points apart and as the photograph goes in jumps of 500 points, the photograph will render these areas as identical. Therefore, it is obvious that we cannot rely upon our eyes to guide us in balancing the light. Not at any rate until we gain some experience in this fascinating part of motion picture photography.

By the use of the monochrome filter, the problem of balancing the light becomes more simple. This filter is a blue glass through which the scene is viewed prior to making the exposure. While the special monochrome filters are best adapted to this purpose, any blue photo filter may be used as an emergency filter. To make such a filter, buy a gelatin "C" filter (Wratten & Wainwright), two inches square and bind it between two squares of glass of the same size. In looking at any scene through this filter you will see a very close approximation of the photograph as it will appear when finished. Not only is this true, but it also degrades light values to some extent, making it easy to judge the values as they will be registered upon the film.

Look at the scene through this filter, with the light falling from one side. The lighted sides of objects will appear quite bright, but in the shadows the detail will be lost. Note this effect carefully so that it may be remembered. The next step is to place the reflectors, so we will pause to learn something of these very simple and valuable accessories.

Reflectors.—A reflector is a flat surface coated with some white substance which will serve to reflect light. In practice, in the studios these reflectors are usually wooden frames two by four feet, covered with wall board. Two of these sections are hinged to fold together in such a manner that when spread out they will make a surface four feet square. This surface is then either painted with a blue-white flat drying paint or white enamel or it is covered with sheet tin or tin foil. The flat paint makes a soft reflector which diffuses the reflected light, the enamel makes a medium hard reflector with a more direct reflection and the metal coatings make a hard reflector which reflects the light in a manner not unlike the action of a mirror. These reflectors are provided with props so that they will stand in any position and at any angle selected. For amateur work, pieces of wall board 18 inches by 3 feet may be hinged with a strong cloth hinge, which reduces both weight and bulk. These reflectors are so easily made and of such great value that every amateur should have at least a half dozen.

One of the most interesting devices recently introduced is the Westphalen reflector for amateur ciné work. This consists of a flexible reflector supported by a folding tripod stand. The whole thing may be packed in very small space, and when opened provides a perfectly efficient reflector for all photographic work. This reflector is even better than the usual rigid type, because of the ease with which a half dozen or more can be transported. As they are remarkably inexpensive it is recommended that the amateur who expects to go in for photo-drama production provide himself with at least a half dozen of this flexible type of reflector.

Take one of these reflectors and so place it that the shadow side of the leading character is considerably lightened, then with others illuminate the other parts of the group. Now have a sketchy rehearsal to see that none of the actors will pass out of the area lighted by the reflectors. When the reflectors are finally arranged, go back to the camera and again look at the scene through the blue glass. If your work has been properly done the scene will

look just about as it did before, but there will be no black shadow, rather every bit of detail can be seen in the shadow and the scene will look, through the filter, about as it looked to the eye before arranging the reflectors. It may be noticed at this place that in almost every instance where special manipulation is employed, it is done, not to create an artificial effect, but rather to overcome the deficiencies of the photographic process to the end that a more natural effect will be secured.

When you have secured the desired result, you will have your lights properly balanced, but be careful not to overdo it. A harsh contrast such as results from the use of no reflectors at all is preferable to the flatness of equal crossed lights, although both extremes will be avoided by the careful workman.

Mirrors.—For special effects, mirrors are used to provide the maximum of hard reflection. These are used principally in securing back-light effects. The amateur will often find a common hand-mirror quite serviceable. By playing a reflection of the sun's rays from a mirror on the side of an actress' head away from the lens, and by slightly shaking the mirror during this time, a beautiful shimmering halo may be secured. Larger mirrors may be used to secure a straight backlighting. The back-light not only serves to add attractiveness to the scene, it also helps to define the distance between the actor and the background, providing a pseudo stereoscopic depth to the picture.

As a rule, in the Northern hemisphere the camera should be pointed in a northerly direction, say from northwest to northeast, providing there are no other important considerations which contraindicate this. This gives us an approximately correct "plain" lighting. In a properly lighted scene, any cast shadows should extend neither to front nor rear, nor even straight out at the side, but rather to one side and toward the rear. The shadow should be at least two-thirds as long as the body which casts it, but not more than twice as long. This serves as a rough guide, not that the shadows of themselves are of paramount importance, although they do play a part, but because they serve as an index of proper lighting.

Very long shadows indicate early or late hours and no scenes should be made at these times except those meant to portray these periods of the day. A vertical sun should never be used unless it is desired to portray a burning hot scene, such as a desert. Remember, such effects are exaggerated in pictures.

The cameraman will play safe in keeping the sun over one shoulder or the other during his early experience.

Light trickery might well be included with other tricks, for with experience comes the ability to so light a scene that its appearance is totally different from its appearance under other conditions. However, such trick or "fancy" lighting is nothing more than a carefully planned mixture of two or more ordinary lightings. The manual control of light belongs in the chapter dealing with artificial light and it will be discussed further in that place.

So far we have considered exterior lighting with a bright sun. It is a fact well known to amateurs that the sun never shines, except when the cameras are all safely at home, so it is quite important that we consider some of the problems which confront us when we have no sun.

First we have those hazy, dull days when even the most familiar objects take on an appearance of mystery and seem to slink away from sight, retreating into the obscurities of the haze. Upon such a day the still photographer goes forth and makes masterpieces—or messes, as the plate may turn out. We have three paths opened to us upon such a day, we may take what may be a frankly record shot of an autumn picnic, we may make the heavy shots of our photo drama in which the villain stars, or we may try our hand at artistic motion picture photography, but in each case we must take into consideration the light, both as illumination and lighting, its strength and direction of fall.

It may be said that there is no direction of fall, but this is untrue. Even with a light so dull that there is no cast shadow, we find that the most intense light comes from that portion of the sky behind which the sun is obscured. We work just the same as though we were working with a bright sun in that direction, except that we need no re-

flectors. In fact, a magnesium flare will help out wonderfully on very dull days, as otherwise we should have a lighting which would be entirely too flat for any satisfactory rendering whatever, as far as good, technical photography is concerned. But, we may take advantage of such light to make motion films which show just this effect, and if we work for this final effect we may expect satisfactory results from any of the above mentioned fields of motion photography.

In working under very black, threatening clouds, we can secure ample exposure without using our largest aperture. The exposure meters will all indicate stops of from f 2.5 to 1.5 for such conditions, but in fact we will use 5.6 or smaller. Exposure meters are calculated to give us a full exposure, which means an exposure which will show us the object in all of its detail. But in a storm scene you do not want this. Which storm scene appeals the more to you, one in which you see a darkish-gray sky, a breeze blowing garments and perhaps a few drops of rain falling, or one which is dull and gloomy, in which objects are dimly seen in silhouette only, and then against the sky? The latter of course! Remember that the full exposure is not necessarily the natural exposure. Our brains often see more than do our eyes. Do not be afraid of underexposure on such occasions.

If you live in a hilly country or one in which there is only a little hill, and perhaps some trees and a brook (almost any city park will present these elements) try to make a storm picture the next time a big thunderhead comes rolling up.

Filters.—There will be, or at least should be, quite a breeze blowing. Calculate your exposure, then put a 2x yellow filter over the lens and give it from one-third to one-half the exposure calculated for normal. Get your subject on the crest of the hill, with the sky behind him. Secure a position where the cloud mass appears the most impressive, and still have the wind blowing across the field of view. Then make the exposure with the filter and diaphragm as indicated. The film will be underexposed and the negative will look like a failure, yet you will be

pleasantly surprised when the film goes upon the screen. This will look like a nasty, wet, cold storm, not the nice little parlor storms so often shown upon the screen. When you show a storm, make your audience uncomfortable by the suggestion of inclement weather, when you show a desert scene, make them fairly pant, and when you show winter make the spectators swear at the janitor for not providing more heat. A motion picture which remains only a picture when it is projected, is more or less a failure, but one which can make the spectator feel that he is actually a part of the scene depicted, whether record, drama or art study, is a success. This effect can be secured only if you use the proper light for that scene, although of course other factors enter into the case also.

(Courtesy Amateur Movie Makers)

Many beautiful night effects can be secured by proper camera manipulation, but they should be made like the scene above, with such exposure that the effect is unmistakably that of a real night scene.

Night Effects.—We then have the night films to consider. This is a subject which for some reason has an intense fascination for the amateur and one which leads to more dissappointment, possibly, than any other type of subject.

There is no reason why any amateur who possesses proper equipment should not make successful night pic-

tures, but first of all let us consider the subject itself.

There is a fascination for many people in the night itself. There is a faint suggestion of mystery in the deep shadows, and the lights, particularly in the cities where lights are grouped in thousands, glitter with a brilliancy which turns the most drab street into a veritable theatrical setting. The factor which gives this appearance is not the lights themselves, which are far inferior in intensity to daylight, but the contrast between the light and the shadow. If we are to reproduce this effect we must retain the shadows, yet this is the very thing which most amateurs try to eliminate.

In the still field there have been innumerable night pictures which have been perfect representations of the scene they are intended to depict. A study of these pictures will show us one or two limited areas which are sharply lighted. These areas give us the key to the picture. The rest of the picture space is filled with shadow of varying intensity, but in which no one object stands out sharply. So in making night pictures we reverse the usual rule. We expose for the highlights and let the shadows take care of themselves. By doing this we retain the deep shadow which gives character to the night picture.

In working with subjects like this try to recall some of Rembrandt's masterpieces. There we have shadow, and more shadow and still deeper shadows. This effect gives to these works their wonderful richness of tone. Light is a thing of beauty, but to render it properly we must make it appear as self luminous, a very difficult thing. Next to this light in beauty are rich shadows, and these we can easily secure by proper photographic illumination—or rather the lack thereof. If you make a night shot in which one object and only one is plainly discernible, and that lighted by a uni-directional light, you will have a scene which is quite convincingly a night scene.

This brings us to a consideration of the subject itself. There must of course be enough positive illumination to affect the emulsion during our exposure which is limited to approximately 1/35th of one second. This means that an unusual amount of illumination must be provided,

such as is found in the more brightly lighted sections of the larger cities. There are also some places such as athletic and flying fields where there is sufficient illumination for making motion pictures at night. In any case it is presumed that the cinematographer is equipped with an exceptionally fast lens, such as the f 1.9 or the f 1.5. With the f 1.5 lens and half normal motor speed, night films may be made under conditions where the illumination is surprisingly faint when compared with the light usually thought necessary for this work.

By working in this way, success may be easily attained in this work, but satisfaction only comes with a realization of the type of film which most adequately represents the illumination of night. Do not try to make a fully illuminated scene after night-fall.

(Courtesy Amateur Movie Makers)
The lighting used in the M-G-M production "The Unknown" featuring Chaney is a splendid example of sympathetic lighting.

CHAPTER FIVE

Interior Lighting

We have seen before that in any photographic process we must have both illumination and lighting, both chemical and visible effects of light. As illumination bears a direct ratio to the lens aperture used, we have our camera lenses equipped with an iris diaphragm which controls the amount of light permitted to pass through the lens. This control is exerted with any kind of light either natural or artificial. To this extent we control illumination. The lighting is, as we have seen, susceptible to control only through the medium of reflectors, screens and similar devices. Even so we can alter the direction of fall of only the reflected light, and we can control the intensity of the light to only a limited extent.

In the consideration of interior lighting, we find conditions which are almost diametrically opposed to these. We still have the control of the amount of light entering the lens, as we had in exterior work, but now we have full control of the initial intensity of the light, full control of its direction of fall, and to a great extent control over the extent of diffusion. The only element lacking is a sufficient maximum intensity of the light. We start with the proposition that the minimum intensity of light is that intensity which will enable us to secure a fully exposed negative in a motion camera operated at normal speed. In addition to this there are other considerations which are of more or less importance.

Any sources of light used for illuminating interiors must be capable of being handled with ease by the usual amateur. This is of course not a vital consideration, but it must be attained before such light sources will become popular. You and I would do without artificial lighting rather than

worry ourselves with a heavy, ungainly lamp. Fortunately, the modern light sources are so easily handled that the illumination of an interior is a pleasure rather than being a drudgery.

And then of course, these lamps must present an appearance which is in keeping with the cameras and projectors used in modern amateur cinematography.

In the consideration of initial illumination, we cannot judge the source of light by its initial candlepower, although this serves admirably as a basis of comparison of similarly colored lights. Thus, in comparing white flame arcs, the comparison of their candlepowers will give us a definite conception of their comparative efficiency, when used under similar circumstances. We cannot, however, compare incandescent lights with arc lights upon the basis of their relative, visual candlepower, because the incandescent is yellow and the arc a white light. The arc will have more effect upon the film per candlepower than will the incandescent light. Yellow light is comparatively inactive from a photographic standpoint, except where panchromatic film is used.

The most practical application we make of the estimation of the intensity of the light is that used in calculating the proper exposure. It is evident that we must know something, either directly or indirectly, of the intensity of the light being used before we can even approximately calculate the exposure. We may not consciously judge the light as being of such and such a candlepower, but we do judge it as requiring the use of some particular lens stop.

We have seen that we photograph objects by means of the light reflected from the surface of such objects. It follows therefore that the amount of light reflected from any given surface is proportional to the amount of light which falls upon it originally, as well as upon the reflecting properties of the surface. Then if a definite amount of light falls upon a group of objects, they will reflect definite proportions of the original light in relation to their power of reflection. Thus we see that through varying reflection we get the differentiation between any two objects, while the total tonal scale of the reflected light de-

termines the exposure. Thus the amount of light which falls upon the subject has a very definite bearing upon the lens aperture necessary to photograph this object at normal speed.

INTENSITY OF LIGHT.—We know that the intensity of any light varies inversely as the square of its distance. Thus if we have our light at two feet distance and move it to six feet distance, or three times as far away, only one-ninth as much light will fall upon the subject. This is the second factor in judging the amount of usable light reflected from any surface. We must then consider intensity and space or distance. Naturally, as we have seen before, the photographic exposure is determined, among other factors, by the duration of the exposure of the film to light. Here we have the *time-space-intensity* equation. These are definite factors, the time and intensity being fixed and the space having a definite bearing upon the calculation. Thus if with a given light we can make successful exposure at f 8 and we move that light twice as far away we know that we must use four times as much light, so we use stop f 4.

When the light is moved twice as far away, use one-half the f value, with it three times as far away use one-third and so forth. Thus moving the light three times as far away would lead to the use of f 3 when f 9 had been the proper light before moving the light.

The f *number* varies inversely as the distance of the light from the subject.

We can now see that with a low initial light intensity we should use a large lens aperture, and with a high intensity light we should use a lens of small aperture. The question now arises as to which combination is better. If we have a light of ten thousand initial candlepower intensity, which enables us to make a satisfactory negative at f 3.5, it is evident that a light of twenty-thousand initial candlepower would enable us to use an aperture whose area is one-half that of the f 3.5. This would be roughly f 5. Conversely, with a lens of approximately f 2.5 speed, we could secure the same results using a light of approximately five thousand candlepower.

As modern lights reach as high an efficiency as one thousand candlepower per ampere of current consumed, we will assume that such is the case. Then the 5,000 c.p. light would consume 5 amperes, and the 20,000 c.p. would consume 20 amperes. The usual house current is equipped with 25 ampere fuses, so that we could safely use 4 of the 5 ampere lights, or 2 ten ampere lights, while we could safely use only one of the 20 ampere lights. Thus we see that there is one decided advantage in using fast lenses and lower intensity of illumination.

Arc Amperage.—Experience has shown us that the practical minimum amperages for arc lights to be used for cinematographic purposes is eight amperes for primary lights and 3 to 4 amperes for secondary lights. With a pair of 8 or 10 ampere lights, cinematography of average home groups in average interiors is possible at normal speed using a lens aperture of f 3.5.

For the fullest possible control, two eight or ten ampere lights, which can be safely used on the usual house line, should be used. In such case, balancing is achieved by variation of the distance between the individual lights and the subject. As a rule then we may assume that for reasons of economy and convenience the combination of low intensity lights with high aperture lenses is preferable to extremely high intensity lights and small aperture lenses.

There are also pictorial reasons for this. The usual interior shot is made with one or more persons as the center of interest. In the case of close-ups and semi close-ups, the high aperture allows us to diffuse the background while retaining abundant detail in the subject focussed upon. At the same time, in full shots, the background is so near the subject that full frame detail may be secured with f 2. Any diffusion which persists in such cases is not objectionable.

If any one lens aperture can be said to be preferable to another, under all conditions, we may say that the f 2 is the most generally useful aperture for interior work with the lens of from 20 to 25 millimeter focus (one inch). It is possible to make use of this stop under most conditions by the proper manipulation of the lights.

The manipulation of the lights is in itself an art, and one which cannot be taught in a short time nor by the use of a few words. We may be able to point out the path, but each experimenter must find his way along this path to the best of his individual ability.

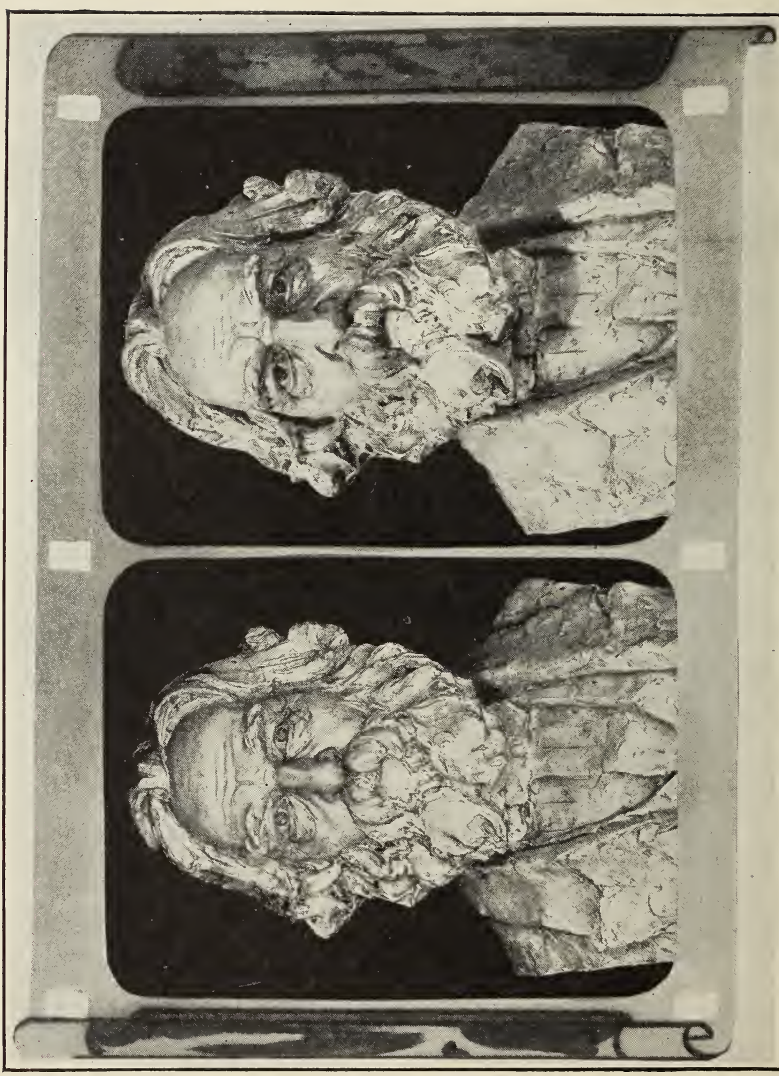
Lighting is not an exact science, but like all arts it is based upon comparatively simple elements. The artistry lies in the proper synthesis of these elements.

We may consider any solid object as being more or less cubical in shape, that is, it has six major surfaces, i.e., top, bottom, front, rear, left side and right side. We may illuminate such an object by a single beam of light in such a manner that the beam will fall squarely upon any one of these surfaces. This gives us six light direction elements.

Synthesis of Light.—The subject of light synthesis is neither difficult nor complex. In fact we do not actually mix different light beams, but we make use of a single light placed in a position midway between two of the primary positions. At times we place it in a position where it partakes of three elementary positions. Thus, the "plain" or "straight" lighting beloved of artists and portrait photographers is a combination of a high light, a side light and a front light. Starting the lamp from the position occupied by the subject move it straight away from the front of the subject, then to one side, and finally above the level of the subject. This last move will bring the light to its final position to provide the proper plain lighting.

As a first step in the consideration of various lights, let us establish the directions. The front of any subject is the side which is directed toward the lens and hence the side which will appear in the completed photograph. Above and below are of course used in the familiar sense. Right and left refer to the photographer's right and left as he faces the subject. Thus "right" actually refers to the subject's left, but as it is the right of the cameraman we use that term. Back means the side hidden from the camera lens.

The first position which we shall consider is the front



1. Light from directly in front.

2. Light from front, side and above. (*Plain lighting.*)

lighting. This is secured by having the light coming from directly behind the camera. This is known as flat lighting for a reason which we shall see. In the consideration of exterior lighting we considered a more or less diffuse light, but now that we are dealing with highly concentrated lights, we may well consider a few more details of lighting as a delineator of form.

We determine form as outline and contour. If we could perceive outline only, a sphere would appear to us as a flat disc. It is evident therefore that the play of light and shadow which was mentioned in the preceding chapter is a thing of considerable importance. To fully understand this place a sphere, such as a celluloid ball or similar object upon a support and illuminate this with a spot light. Better effects will be secured if this ball is white in color.

We will at once perceive the outline which is circular. Moreover we will notice a spot of intense highlight on one part of the ball. This spot marks the point at which the rays of light emanating from the light source are reflected to the eye. As we move, the position of this point changes, so we see that its position is established by the positions of both light and camera (or the eye). From this spot the surface of the sphere becomes progressively darker, giving an appearance of roundness. This appearance naturally depends upon this gradation of the light tone, therefore:

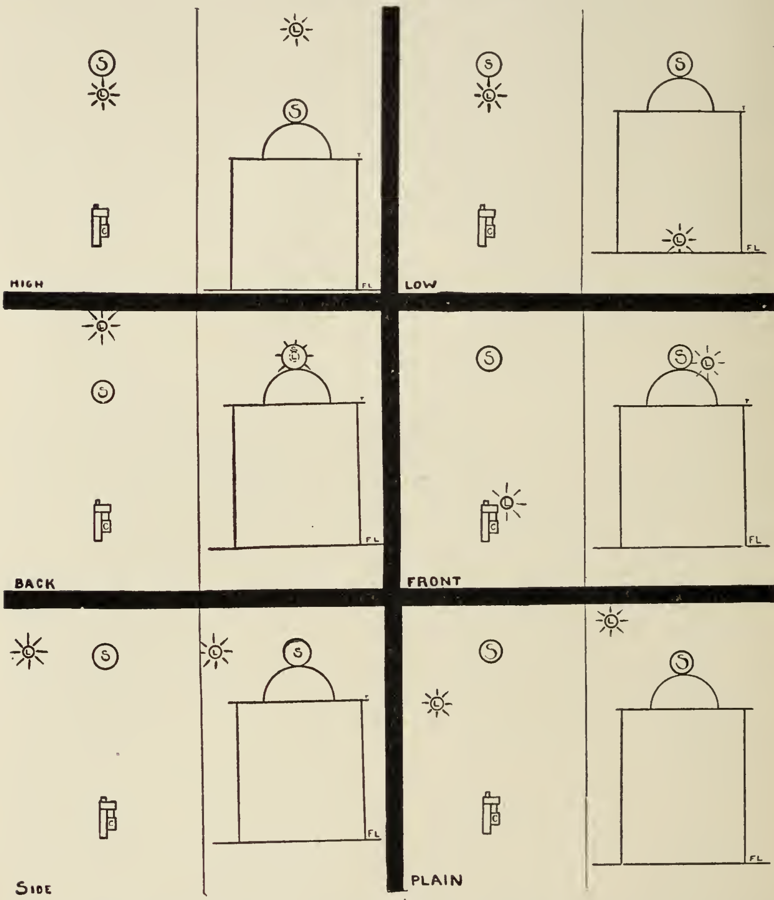
The quality of any photograph, moving or still, depends upon the preservation of the tonal quality of the original.

Incidentally this requires an exposure which very closely approximates the correct exposure.

Now if we stick a lump of modelling wax upon the surface of this ball, we at once get a sharp cast shadow upon the surface of the ball and a second series of graded tones upon the lighted surface of this wax. These two things at once tell us the approximate shape of the wax lump in a manner which is easily reproduced in our photograph. Therefore:

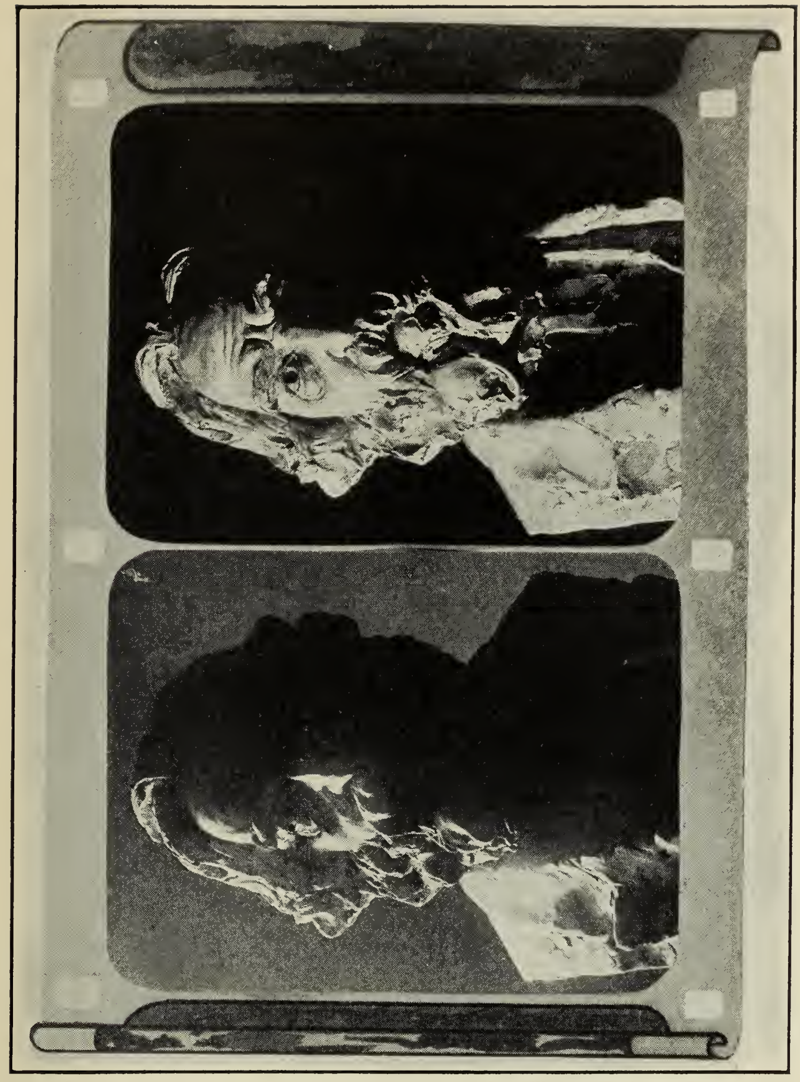
Photographic representation of form is secured by reproduction of both cast shadows and graduated tones.

Then, photography deals with shadows exclusively. A pure highlight means nothing in photography except as it is given form by circumscribing shadow tints.



These diagrams illustrate the positions of subjects, camera and light used in making the six lighting studies shown in this chapter. The left hand portion of each diagram indicates the floor plan while the right hand portion indicates vertical positions. FL is the floor line, T the table upon which the cast was placed for photography.

The third consideration is one of modification. When we added cast shadows to aid in the identification of form, we added areas of blackness. Pure black, like pure white has no place in a photograph except in severely limited areas. We must retain our cast shadows, but we must also illuminate the area covered by these shadows



1. Light from side-rear

2. Pure sidelight.

with a light of inferior intensity, so that while maintaining clearly the form of the shadow, we can also see the detail of the surface upon which the shadow is cast. This gives us "luminous" shadows. In the photograph this effect may be secured without in the least affecting the effectiveness of the shadow itself. The light used for this purpose is known as the secondary light.

Now let us return to a consideration of our front lighting. Here we have a primary light only, and one which is so placed that cast shadows are eliminated. Our perception of form is limited to that disclosed by the tonal gradation only. Thus we perceive the "roundness" or general spherical shape of the features themselves, but we have nothing by which to judge the "elevation" or degree of protuberance of the features from the general level of the face. Thus we have a pseudo-likeness which appears singularly lacking in depth. In other words it appears to be flat, and so striking is this effect that we call such lighting a flat lighting. It is to be avoided above all things, and it is the one primary lighting which can never be successfully used, alone.

In the consideration of other forms of primary lighting it will be noted that each one has some individual characteristic, giving to the subject some definite expression or appearance. In mixed lightings, the subject will be given to some degree the characteristic of the predominating primary lighting.

Let us consider the side-light. This is a strong light, and brings the contours of the subject into strong relief, producing in fact an exaggerated depth. You will also notice that this light makes the subject appear narrower and longer. A round faced person lighted with a strong side light predominating will apparently have a narrower face than in real life. We see here the power of the shadow in producing the illusion of the third dimension. This lighting can be used in certain scenes where strong lighting is needed, such as a person standing in a door or window with the light shining through the opening. The shaded side of the actor will then blend into the shadows producing a striking effect.

1. Light from above.

2. Light from below.

When we move the light to a position above the subject, we note a far more striking effect. The eye sockets appear more deeply sunken, while the features are lowered, the face becoming more wide and short. This lighting brings out an expression of calm, rugged, self reliance. This may be a point to remember in your future work. Also note that much of the nobility of the face is lost, but there is little if any actual loss of character. Of course the nature of this character is changed, but the face remains as individual as ever.

When we lower the light to a point immediately below the face a great change is effected. The face still seems broad and short, but the expression is now wistful and pleading, a sorrowful countenance indeed. In many cases this low light brings out a weird and mysterious aspect in an entire scene.

Finally we have the plain lighting, where the primary light is placed in front of, above and at one side of the subject. Here and here only do we receive an exact mental impression of the actual appearance of the original. Here we see a photograph for which an entirely different subject might have been posed. It is for this reason that a cast was used instead of a living model. With the inanimate cast it must be evident that the striking differences in the various poses is due to the lighting used and to that alone.

It may be remarked in passing that the backlighting is not shown in this series, but a side-back light substituted. This has many of the characteristics of the side light as will be seen. The reason for this substitution is that the backlight is effective only when there is some transparent or translucent substance between the light and the camera, such as light fabric, hair and so forth. This substance serves to refract the rays of the backlight, giving us the characteristic halo of that light. A living model has been used for the purpose of illustrating the backlight. It can rarely be used alone, as without some front lighting the subject would appear as a black silhouette surrounded by a glaring halo or brilliant light.

Let us now consider our first interior scene. For the

sake of simplicity we shall use but a single actor. Try to pose this actor in such a manner that no pieces of furniture or other incidental objects will cast confusing shadows. Keep the "set" and "properties" within the simplest possible limits.

Backlighting is very effective when we have a feminine subject with soft hair and a suggestion of diaphanous drapery to refract the light.

Set the camera upon a tripod, and adjust it to take in the field you wish to include in this, your first shot. We will assume that you are using a single lamp. The camera set up is secured by the use of the ordinary incandescents

used for normal room lighting. Limit the field to about 4 feet high by 6 wide. This will give you approximately 24 square feet of included surface in the plane which is occupied by your subject. To secure the maximum results from your lamp, set it in such position that its entire output is confined to practically this area. You can control this to a certain extent by properly setting the "wings" or side reflectors of the lamp, which serve to concentrate the light to a slight degree. For most purposes, you may consider the effective angle of the arc as 90 degrees.

For a four by six area you should place the lamp about three feet from the subject to utilize the original 90 degrees, but as this is too close for practical purposes, you will move the lamp until it is from six to eight feet away from the subject, and close the side reflectors until every possible ray of light is falling upon the subject.

Let us assume that this subject is an adult, standing, and you are making a semi close-up, cutting at the waist. The average height of the adult may be taken as five feet and eight inches. Your lamp will be placed about five feet in front of the subject, six feet to one side and about seven feet from the floor. This will give the side-front-top light desired. Now hang a sheet or Westphalen reflector in such a position that the light from the lamp is reflected upon the side of the subject which is in the shadow. Arrange this reflector so that the deepest shadow is illuminated to such an extent that the detail is barely visible when viewed through a monotone filter.

The camera is now placed from twelve to fifteen feet away, and focussed upon the subject. The exact position of the subject in the frame will have to be determined by trial and error, moving the camera in different directions until the image of the subject occupies a position and has a size which meets the approval of the cinematographer.

The final step is the determination of the exposure. For interior work, when a rapid calculation is desired as well as an accurate one, the value of the photometric meter of the Cinophot type cannot be overestimated. This meter will give the exposure just as rapidly and just as accurately for interior as for exterior work.

When the diaphragm has been set, the lamps are reset, that is the arc is regenerated, and the exposure is made in the usual manner.

When two lights are used, the reflector may be replaced by a lamp of inferior intensity, or it may be replaced by a second lamp of equal intensity located at a greater distance from the subject. In balancing lights, remember that the intensity of any light varies inversely as the square of the distance from the surface illuminated.

In addition to these primary and secondary light sources, a spot light will be needed. The spot light is used for backlighting, for accent lighting and for building up the illumination in any desired place. In backlighting it is placed behind the subject. In case this is to be used while the subject is in motion, this light is placed outside the lines and an operator placed beside it whose duty is to keep the "spot" upon the rear side of the subject's head. The fact that the light comes from one side as well as from the rear does not spoil the effect. In fact, it in many cases enhances this effect. This is one of the best known lighting effects for differentiating the plane of the subject and the plane of the background.

Accent lighting consists of accenting, or emphasizing any particular part of a scene by means of additional concentrated light. The spot light usually throws a circular area of light with more or less sharply defined edges. This means that any object illuminated by the spot will be brightly illuminated, and if the exposure is calculated for this intensity of illumination, other portions of the scene will be slightly underexposed. Thus we have the subject of greatest interest standing out sharply against a slightly dull background.

The spot is also useful for special effects, such as full moon spots, and similar "fancy" lightings, but as there is no limit to the number of such lightings which may be devised, we can hardly take space here to go deeply into this subject. The ingenuity of the cameraman will enable him to devise new lighting effects once he has become sufficiently accustomed to artificial light to feel at ease when handling it.

1. A set up for making interior movies. From left to right we have, Cameralite twin-arc, Victor camera with Goerz set on home portrait stand, Little Sunny arc and Westphalen reflector.
2. The picture upon the film.
3. Making the exposure.
4. The Cameralite and Little Sunny in front of the Westphalen reflector.

Emotional Effect of Lighting.—It should be remembered, however, that any lighting will have an effect upon the picture which is entirely aside from either illumination or lighting. This may be called the sympathetic effect of lighting. Reference to the illustrations of this chapter as well as individual experimentation will show that with any given subject the expression, the "atmosphere" of the entire scene may be changed by changing the lighting. By fully understanding this we will find that lighting can aid us to a very great extent, or place an almost unsurmountable obstacle in our path in "putting over" a scene, more particularly if this scene has an emotional "punch."

The basic law of art is unity, so no matter whether we are making purely artistic films, or whether we are making the most elementary photo-dramas, we must remember that everything entering into the production of one particular scene must either aid in producing the necessary "atmosphere" for that scene or be eliminated. This includes the lighting as well as other details. If the scene is one depicting sorrow, let us have gloom, but not a gloom of heavy black shadows, rather a flat lighting, without excessive contrast, and then let us give it an exposure slightly on the under side. This, however would be too flat, so let us use the spot to introduce a bright spot of sunshine falling through a window, or introduce it in some similar natural manner. This small area of brightness will add life to the picture while increasing the effect of the general tone of the scene through contrast.

Let your lighting reflect the spirit of the scene!

Would you depict a scene of mystery by fully lighting every detail and then having your actors slink about like children playing Indian in the sunlight? I trust not! Rather you use just enough primary illumination to make one mass distinguishable from another. You see shadows rather than actors. Then, to heighten the effect you shoot a spot into a face or even flood the entire scene with a pure side or high-side light.

We might go on indefinitely considering the various treatments which might be used in connection with the lights, but as long as the cinematographer is careful to

use a lighting which is appropriate for the spirit of the scene in hand, he will not go far wrong.

The lamp is the brush with which the cinematographer paints his picture. The artist-cinematographer is not content to record things as they are; he wants to show them as they impress him. This means that he must add something intangible to the physical form of the subject recorded upon the film. He must capture spirit and emotion and imprison them upon his celluloid ribbon, and for this purpose, nothing is more efficient than the lamp.

It will be seen then, that of all accessories offered for amateur use, there is not one which can really surpass in importance the arc lamp. Not only does it simplify the problem of exposure, not only does it permit the amateur to make motion pictures within his home, not only does it open the evening to this fascinating pastime, but it also places in his hand an artistic implement whose possibilities are unlimited.

Having considered the use of artificial light and artificial light sources, let us now consider the specific mechanisms which produce the most satisfactory artificial illuminant for amateur cinematography, the arc light.

Many amateurs cannot understand how, using only a small arc lamp it is possible to secure sufficient illumination, to make motion picture film. The lights used do not of course compare with sunlight in intensity, but this is not necessary. In the first place, we use only a small portion of the colors which compose sunlight, in photography, perhaps one-tenth of the light which affects our eye, while the artificial light, especially the arc gives us a light whose color is almost entirely used in the photographic process. Again sunlight illuminates an immense area. We can photograph objects miles away if they are large enough to be seen. With the artificial light we illuminate a strictly limited area, so that while sunlight may be millions of times as strong as our little arc, we can make use of both. To fully understand this, we must ignore the total intensity of sunlight and consider only the photographic power of the light which is reflected into the camera by one unit of surface, say one square inch.

By using this as a basis of comparison, we find that our small portable lights will give such a reflection not greatly inferior to sunlight. The fact remains that satisfactory amateur cinematography may be carried on indoors by the light furnished by a single one of the small, modern cinema arc lights. Two are better of course, as we have seen, but one will serve.

Let us compare the arc, which is the most common amateur cinema light, with daylight.

ARC	DAYLIGHT
Constant in intensity giving us a stable factor for calculation of exposure.	Variable intensity making necessary a complete exposure computation for each exposure.
Ready for use at any time.	Have to wait for favorable light or risk spoiling shot.
Intensity varied to known degree by varying distance between subject and light, or by adding more units.	Intensity not under control, but naturally erratic.
Position relative to subject under control, allowing the best illumination for each particular subject.	Proper illumination only possible by changing position of subject with regard to the sun, which often spoils a desired effect.
Limited area of source allowing more definite modelling.	Diffused light which must be screened or reflected to secure proper modelling.
Vertical angle secured and maintained at will of cameraman, giving good, effective lighting.	Vertical angle constantly changing which will give a changing light effect, which is not too good.
Allows the busy man to make films during that period which is almost his only leisure, the evening.	Limits film production to daylight, and even then to periods when suitable light is present.
During rainy, cold and stormy weather the arc enables the cinematographer to go right ahead with his work.	Bad weather results in the camera being shelved.
Stop motion, cartoon work,	Daylight is too variable to

animation, time condensation and in fact almost all trick and scientific work can be properly performed *only* with artificial light.	permit exposures at predetermined times through an extended period.
The arc is practical for use only with limited areas, the exact size of such area changing with the type and number of lamps employed.	No limit to area included in photograph other than mechanical limits imposed by intervening objects.
Artificial light essential for title work.	Daylight entirely unsuited for title work.

So we find in the artificial light, a source of light which while limited in intensity is quite adequate for our purposes, and which is at all times under full control. The advantages are obvious when compared with the sun, which while supplying an unlimited amount of light (sometimes!), is erratic, capricious, and absolutely out of our control! The conclusion is obvious. The amateur who wants to make good films, the amateur who wants to make home films, the amateur who has dramatic aspirations, and the one who wants to add art to his work will all make full use of the artificial light. Only in making frankly exterior shots, which rarely have the value to us of the interior shot, can daylight be preferred to artificial. Of course, we do not mean to say that outdoor cinematography is a failure. Far from it! But the amateur never knows more than half of the enjoyment which his camera can provide until he has worked indoors with artificial light.

THE ARC LIGHT.—The arc light is the most practical source of light for the commercial or industrial cinematographer as well as for the amateur. For this reason a few words regarding the arc as a type will not be amiss. If we attach two sticks of carbon or metal to the ends of the two wires which form an electrical circuit, touch the ends of these rods and then pull them apart, the current will continue to flow across the air gap. When the rods touch, the resistance to the passage of the current at the point of contact causes an intense heat to be generated. This heats the air and permits the current to flow across this hot air gap up

to a certain limit. Beyond this limit, the force of the current will not carry the flow across the gap and the arc is broken. This simple form of lamp is not practical, because without a resistance to act as a gate, such a tremendous amount of current would be drawn across the arc that the connecting wires would be fused. When we add the resistance, this acts as a gate allowing only a certain amount of current to flow. This protects the line. In addition, fuse plugs are used of a sufficient capacity to take care of the rated current of the lamp. Arcs as used for motion photography by the commercial and amateur worker usually have a maximum pull of twenty or twenty-five amperes. They should only be used on lines where wiring has been installed which will carry such a load. A twenty ampere lamp will often blow twenty ampere fuses, so twenty-five or thirty ampere fuses should be used. For use on ordinary lines a ten ampere draw is provided by a switching arrangement. This cuts down the light out of all proportion to the current, ten amperes usually giving about one-fourth the amount of light furnished by the same lamp on twenty amperes. For this reason manufacturers have devoted their attention to producing a lamp which would give adequate light from a ten ampere current.

It has been found that the material used in making the arc rods has much to do with the photographic power of the light. This has led to experimentation with the result that these rods are now made of a special carbon. Through the center of this carbon rod is a hole. This hole is filled with a compound which gives an intensely white flame. In this manner, a small ten ampere lamp which may be plugged into any ordinary house socket will actually give a more powerful light than was obtained from the old time, heavy current lamps using solid carbons. So we find this type of lamp divided into two large classes, the double range arc which gives roughly 5,000 candlepower on ten amperes and 18,000 to 20,000 candlepower on the twenty ampere pull; and the amateur lamps which give from 10,000 to 12,000 candlepower on a ten ampere pull. The latter type of lamps are made so that even at the instant of making the arc the current consumption will not rise

above ten amperes. Such lamps may be safely operated on any ordinary house current.

A simple arc will gradually increase the current consumption as the carbons are consumed and the path of the arc becomes longer and longer. In the older type of lamp screw controls were arranged so that the operator could manually move the carbons closer together as they burned away, but this required almost constant attention which would greatly decrease their value to the photographer. Moreover the old time arc spluttered and spit and had a constantly varying light intensity. This was not of so much moment in still photography, but it is fatal in motion photography with its 1/32 second maximum exposure.

The next improvement was a magnetic arrangement whereby the arc constantly renewed itself. When the arc grew to a certain length the upper carbon would drop upon the lower and be jerked away again instantly, renewing the arc. This arrangement is still used in some lamps, but not in the most modern forms.

The modern photographic arc lamp has special carbons which give an intensely white light, with extreme photographic power. They are so arranged that the arc is started manually, after which the arc will burn for a predetermined time and then go out, unless renewed manually before the automatic extinction takes place. Four or five minutes, the usual length of time for these lamps to burn, is ample for making an exposure of a single scene, with time for focussing and final checkup on the setup before the actual exposure. In case the lamp is left burning it will be extinguished automatically, which is in itself a valuable feature. Moreover these lamps burn with very little noise and without flickering, or spluttering.

CAMERALITE.—One of the most outstanding lamps for amateur use is the Cameralite made by the widely known firm of M. J. Wohl. This lamp is made of sheet metal, and shaped like a rollfilm camera. It measures 3¼ x 6 x 11 inches and weighs six pounds. While it is rated at 8,000 candlepower for use over an area not to exceed fourteen square feet, the lamp will deliver about 12,000 candlepower. The writer has used it very successfully with an

f 3.5 lens for making motion pictures at normal speed, with results which were satisfactory in every way. This is one of the first lamps to be developed which could be safely plugged into any house current yet which would in itself supply sufficient illumination for motion picture work. For this reason it is proving very popular.

This lamp has several unique features. The entire equipment, including extra carbons, cord, tripod adaptor and table stand all pack within the lamp itself so that no carrying case is needed. The lamp of itself is the case. This enables the photographer to carry his lamp into a house without giving the appearance that he is moving in for a month's visit.

The usual objections to the use of an arc by amateurs are that the lamp is likely to blow fuses or even endanger the wiring of an ordinary house current, it must be constantly adjusted or else the automatic feed kicks and splutters at just the wrong instant, the lamp spits and flickers, and when the carbons burn down, the lamp must be allowed to cool before renewing them. All of these objections have been overcome in the Cameralite. With its intense light it does not pull more than ten amperes, even when making the arc. It gives a pure, steady, flickerless light for four minutes without attention, and this time may be extended at any time by manual control at such time that the adjustment will not interfere with making the picture.

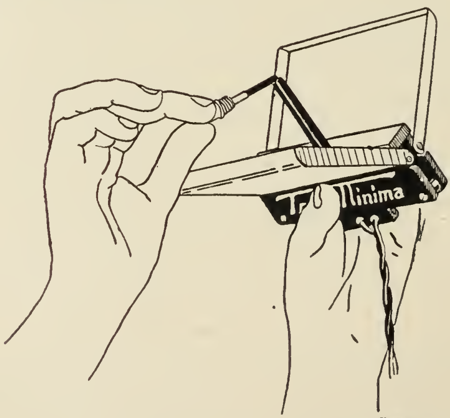
When the two doors are opened, the cord is seen in the case, this is lifted out. Then we find a supply of carbons, the table stand, the tripod adaptor and the carbon connector as well as the handle for manual support. This handle is screwed into the socket provided for it. The table stand is opened and locked in position with the thumb screw provided, and set up on the table. The lamp is now placed on this stand by inserting the stand rod in a hole bored in the handle. This supports the lamp firmly upon the table. Two short carbons are now inserted in the lower carbon sockets. Two long carbons are inserted in the holes in the top of the lamp. The fibre control handle which protrudes a short distance from the side of the lamp is depressed. This allows the upper carbons to fall into place, resting

upon the points of the lower carbons after which the lever is released. The carbon connector is now used to connect the tops of the upper carbons. The connecting cord is plugged into the house line and into the light. This completes the setup. The lamp is now ready for use.

Turn on the current. Nothing will happen. Now depress the fibre control handle. The carbons will drop and will spark somewhat. Before allowing the control handle to rise, *look away from the carbons* for the brilliant, actinic light is very painful to the eyes. Allow the control handle to rise slowly. As it rises the arc will form, flooding the room with a dazzling white light.

The lamp will now burn for approximately four minutes, when it will go out. Should a longer period of light be desired, all that is necessary is that the control handle be depressed again. This will dim the light only during the actual depression of the handle. The light will then continue to burn for four minutes from the time of the last depression of the handle. Thus a continuous light may be maintained.

The Cameralite is a valuable and appropriate addition to the amateur ciné equipment.



(Courtesy Bass Camera Co.)
The Traut-Minima "pocket" arc light.

Traut-Minima Arc.—Another amateur arc which is proving very popular is the Traut-Minima pocket arc. The description is not a figure of speech for the lamp can ac-

tually be placed in an ordinary coat pocket. It is made not unlike a metal cigarette case, with a fibre back. When closed the lamp itself measures 4 x 5 x ¾ inches. It is provided with a long connecting cord. When opened, the lamp measures over all projections including fresh carbons, 4 x 5½ x 6 inches. The carbons are cored, white flame photographic carbons, arranged parallel to each other. These carbons are 5/32 x 2½ inches, about the size of the lead in a drawing pencil.

The resistance used is a separate unit which measures 2½ inches in diameter by 3½ inches long. The 110 volt house line is connected to the resistance box, and this in turn is connected to the lamp. Special connectors make it impossible to connect the lamp directly to the house line. When the current is on, a red pyralin button is unscrewed from the top of the case and withdrawn. This button holds a piece of carbon about an inch long. This is placed in contact with the points of the two lamp carbons and then removed by pulling downward across the ends of the carbons. This generates the arc. The light is of approximately 5,000 candlepower, at a line pull of 4 to 5 amperes. These lamps may be mounted upon tripods or upon special stands. This lamp is a German product, but is distributed by the Bass Camera Company.

The Minima is purposely made in a small size so that two or more may be used in place of the more usual single lamp. To encourage a more highly professional style of lighting in amateur work, these lamps are offered in special sets of three. This gives a primary light of about 12,000 candlepower for use either as a unit or separated for floodlighting and a third or secondary light for balancing. With these three lights some very good lighting effects indeed can be secured.

These lights are thoroughly dependable and have proven satisfactory in the hands of many amateurs.

Little Sunny Arc.—Another lamp of similar design but greater capacity is the Little Sunny, a Westphalen product. This lamp also uses parallel carbons, but these are 6½ millimeter by 10 inch carbons of the white flame photographic type. The lamp folds into a very compact

package. When folded the lamp measures 2½ x 5 x 7 including the connecting cord. The resistance is built into the lamp body itself.

This lamp is generated in the same manner as the Minima. A carbon rod with an insulated handle is brought into contact with the points of the lamp carbons and then drawn downward across the ends of the carbons. This should be done rather slowly as the generated flame must heat the air surrounding the arc to make possible the passage of the flame across the carbon tips.

The Little Sunny draws only eight amperes and gives approximately one thousand candlepower per ampere of current consumed. In fact most of the modern, small, high intensity arcs for amateur use will deliver this approximate output. Any arc operated at less than the rated voltage will suffer a drop in initial intensity entirely out of proportion to the drop in current pressure.

The Little Sunny is provided with a wooden handle for hand use, but like the other lamps of this type, it is also arranged for stand use, a suitable stand being supplied by the manufacturer. This is a feature of this type of lamp, and which applies to all three of the lamps discussed so far. The lamp may be held in the hand and thus supported in any unusual position, enabling the operator to secure just the effect he desires. The use of two of these lamps is recommended, but in case the operator wishes to use one only, the same manufacturer supplies a special reflector which, by means of its stand, may be placed in any desired position, providing secondary light by reflection. This enables the cinematographer to make double use of his light but of course the intensity is not as great as when a second lamp is used for the secondary lighting. This reflector, it may be added, makes an unusually serviceable reflector for exterior work and one which is far more compact than the compo-board type described in the preceding chapter.

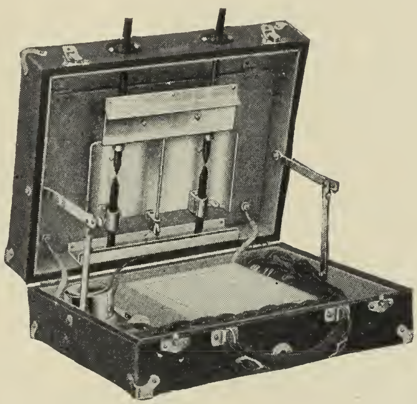
This reflector has a surface 36 x 58 inches and is supplied with a six foot stand. When packed for transport the package measures 18 inches long by two inches thick.

The arc lamps which have just been described are essen-

tially amateur cinematographic lamps. In actual practice they are very widely used by professional photographers as well as by industrial and commercial cinematographers, and they give full satisfaction in such work. They are amateur equipment in the sense that they are simply made, will serve a great variety of purposes, are compact, light in weight and comparatively inexpensive.

They are made to be used as either hand or stand lamps. Any of the three may be safely used in any ordinary home, and for short periods any number may be used provided the total consumption does not exceed twenty amperes.

They give an extraordinary photographic power in comparison with the current consumed. They are the safest of lights, in fact all that is required for extinguishing the arc is a sharply blown breath against the arc. The parallel arcs may be extinguished by swinging the lamp to one side with a quick motion. Yet, in spite of this, they will burn in any desired position, may be moved about to secure the best possible lighting effect and are thoroughly flexible.



(Courtesy Halldorson Co.)
The Halldorson amateur cinema arc light partially folded.

Double Range Arcs.—The next class of lamp is the advanced amateur or semi-professional type which is a miniature reproduction of the twin-arcs used in the large studios. These lamps are made for stand support and are not designed for hand use. They are usually made in the double-range type. That means that by a special switch-

ing arrangement the lamp may be operated on either of two amperages. In case a lighting circuit is available which will not stand the full drain, the lower current pull is used at a sacrifice of initial illumination. These lamps usually consume 10-20, 12½-25 or 15-30 amperes. In any case, only the higher consumption, i.e., 20, 25 or 30 gives the full efficiency of the lamp. These lamps are ideal for commercial and industrial work in the studio, but should not be used on the high current pull by amateurs, unless an electrician certifies the electric installation to be heavy enough to bear the current drain of the specific lamp used. In case the circuit is certified for one or two lamps, do not think this evidence that it will stand three or four. Find out from your electrician just what current drain the circuit will stand and then keep the total amperage of all lamps used within this limit.

There are innumerable lamps of this type being manufactured, and new ones appear every day, so we shall discuss only some typical styles.

THE GELB SPECTRO-SUNSHINE LAMP

This lamp lies midway between the type just described and the advanced amateur type, in that it is small, compact, may be hand held or used upon tripod. It may be packed "hot" immediately after use through the ingenious design of the lamp. Various types of carbons are supplied, including ultra violet for use with quartz lenses in ultra rapid photography.

SIZE—In case 6¼ x 10½ x 12½
In double case (Two lamps) 6¼ x 14 x 22

WEIGHT—Single case 16 pounds
Double case 32 pounds
Tripod 3 pounds

STAND—7 feet maximum, tripod style, also low table stand

TYPE—Twin arc

VOLTAGE—100-125 A. C. or D. C.

AMPERES—10 and 20

CANDLEPOWER—18,000 on 20 amperes

CARBONS—⅜ x 12 upper
⅜ x 4 lower
Both white flame photographic

DIFFUSER—Ground pyrex glass integral with casing
TILT—Vertical or 30 degree tilt
OPERATION—Automatic for five minutes
CASE—Metal, black crystallized enamel. Arcs completely enclosed and dustless. Entire front hinged
Connecting cord supplied

THE WOHL DUPLEX JUNIOR

SIZE—In case about 23 x 12 x 8
WEIGHT—Complete 26½ pounds
HEIGHT OF STAND—6½ feet, maximum
TYPE—Twin arc
VOLTAGE—100 to 125 A. C. or D. C.
AMPERES, D. C.—10 and 20
CANDLEPOWER—18,000 maximum
UPPER CARBON—10 m/m x 10 inch star core, white flame
LOWER CARBON—10 m/m x 4 inch star core, white flame
DIFFUSER—Tracing linen 20 x 20 inches
CORD—20 feet cable with connector
OPERATION—Approximately 4 minutes burning after arc generation.

AUTOMATIC WOHLITE

This is a fully automatic arc lamp of the highest type and is a general favorite with advanced amateurs, amateur producers and industrial cinematographers.

SIZE—In case 23½ x 14 x 8½
WEIGHT—Complete, 36 pounds
HEIGHT OF STAND—6½ feet maximum with folding stand
TYPE—Twin-arc in series
VOLTAGE—100 to 125 A. C. or D. C.
AMPERES—10 or 20
CANDLEPOWER—On high amperage, 18,000
CARBONS—10 m/m., x 10 inch for upper, same 4 inches long for lower, both star core, white flame
DIFFUSER—20 x 20 inch tracing linen
REFLECTOR—9 x 9 inch
OPERATION—Fully automatic from arc generation until carbon is consumed.

THE HALLDORSON CINEMA ARC LAMP

This lamp is made by the well known firm of Halldorson. It is their arc lamp made for amateur use particularly.

It is so arranged in the leather covered case of insulated wood that the case is opened to serve as reflector and lamp support. It is placed upon the stand with the two halves of the case opened. In transport, the accessories are placed inside the case which is then closed and resembles a neat over-night bag. No extra carrying case is necessary.

(*Courtesy Halldorson Co.*)

The Halldorson amateur cinema arc light set up for use.

SIZE—Closed, 5 x 11½ x 14½
WEIGHT—Complete, 23 pounds
TYPE—Twin arc
VOLTAGE—110-114 A. C. or D. C.
AMPERES—10 or 20 (Double range)
CANDLEPOWER—On high range, about 18,000
CARBONS—Upper 3/8 x 12, lower 3/8 x 4, both Photo White Flame, cored
DIFFUSER—Ground glass to replace the standard clear glass spark shield

CORD—15 feet heavy cord with connector.
OPERATION—Semi-automatic, burning four to five minutes after each generation.

THE LEOTY PORTABLE.

This lamp is different from most of the portable types of lamp now on the market in that it uses a single arc instead of two arcs in series. The manufacturers claim greater efficiency due to larger separation of the carbons. The lamp gives satisfaction in the hands of commercial photographers and amateur cinematographers.

WEIGHT—Complete, 18 pounds
TYPE—Single arc
VOLTAGE—105-115 A. C. or D. C.
AMPERES—12½ to 25 and 17½ to 35
CANDLEPOWER—12,000 and 25,000 maxima
CARBONS—3/8 x 12, white flame, cored
DIFFUSER—Cloth
CORD—Connecting cord supplied
OPERATION—Automatic from generation until carbons are consumed

THE PERKINS DA-LITE

This is a twin-arc lamp of the usual type, and one which is well made and which will give full satisfaction. The three Perkins lights listed here have been widely used and are greatly liked by amateur cinematographers as well as commercial photographers and industrial cinematographers.

SIZE—Folded—4¾ x 8⅜ x 13
WEIGHT—9½ pounds
TYPE—Twin arc
VOLTAGE—100-125 A. C. or D. C.
AMPERES—10
CANDLEPOWER—Approximately 10,000
CARBONS—8 m/m x 12 inch, white flame
CORD—Supplied with lamp
OPERATION—Automatic
REMARKS—Made particularly for use in groups of two or more lamps in amateur cinematography

THE PERKINS JUNIOR

WEIGHT—23 pounds
TYPE—Twin arc
VOLTAGE—100-125

AMPERES—12 and 20 D. C. or A. C.—60 cycle
CANDLEPOWER—Maximum about 18,000
CARBONS—3/8 inch x 12 inch, white flame
DIFFUSER—Cloth
CORD—20 feet long
OPERATION—Fully automatic
REMARKS—Automatic stand locks at any height from 30 inches to 7½ feet

THE PERKINS LITTLE GIANT.

This is an unusual type of hand arc lamp. It may be used for both general lighting or for accent lighting in close-ups and other similar work. It is a special purpose lamp whose value will be recognized by all workers.

SIZE—Convenient for holding in the hand
WEIGHT—2½ pounds
TYPE—Single arc
VOLTAGE—100-125 A. C. or D. C.
AMPERES—15
CANDLEPOWER—About 12,000
CARBONS—White flame
CORD—Supplied
OPERATION—Manual
REMARKS—Special type of commercial lamp well adapted for amateur cinematography

There is very little choice among the lamps offered except as to type. Of the two types, the first group of low amperage, high candlepower, portable lamps are very attractive to amateurs and all three have been used by the writer with the fullest possible satisfaction. The second group of higher amperage and lower comparative candlepower lamps are suited more for amateur photo-play production where power wiring may be installed.

Of course, these lamps may be used on their low amperage connection in almost any home, and for short periods the average wiring will stand a 20 ampere draw, but if this is continued it may damage the installation. For the industrial worker, the commercial worker, the scientist and others engaged in special work, the second type of lamp offers decided attractions.

It must be remembered that in so far as actinic or

photographic power is concerned, these double range lamps give about one-fourth the light at ten amperes as they do at twenty, so that for the maximum efficiency, your electric supply must come through 25 ampere fuses or larger. For using the ten ampere range of the two range lamp you must use fifteen ampere fuses and for the Cameralite, Little Sunny, Traut-Minima and similar lamps you will use ten ampere fuses. These sizes are minimum, larger sizes may be used if desired, but do not throw a too heavy load on the house line until an electrician advises you as to the load which the wiring will safely carry. Homes which are equipped with electric heat, electric refrigeration, or other power lines can usually arrange to plug in the arc on these heavy duty lines and in that way two or even more of the heavier duty lamps can be used on the 20 ampere pull.

There is hardly a field in amateur or even commercial and industrial cinematography which cannot be fully covered by the use of one or more types of the lamps described.

Bear in mind when using arc lights of any kind, that the light *must never be extinguished by throwing a house lighting switch!* Always extinguish the light by pulling the plug out of its socket. An ordinary switch would arc and fuse the metal, possibly causing a short circuit which would blow the line fuses. When through using an arc light, *pull the plug!*

CHAPTER SIX

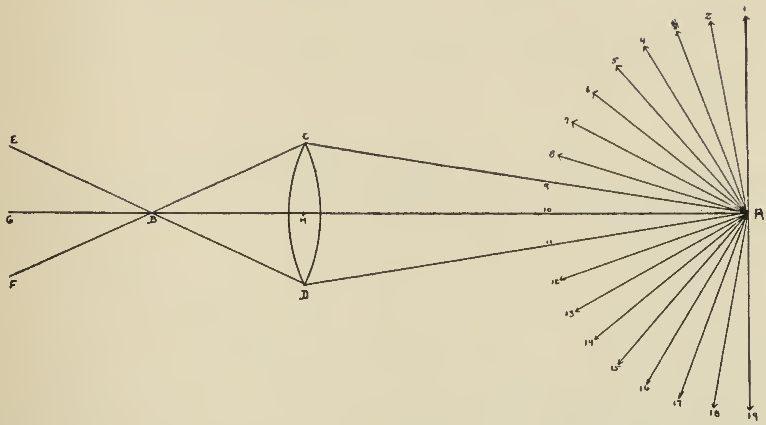
LENSES AND OPTICAL ACCESSORIES

There seems to be a certain vagueness concerning the bit of glass set in the front of a camera. What is it? Why is it necessary? and what does it do?

(*Courtesy Eastman Kodak Co.*)
Ciné Kodak Model B with f 1.9 lens equipment.

If you impatient non-technical readers will excuse us for a few paragraphs, we will try to skim over the surface

of this subject and you can then join us again for the discussion of specific accessories and lenses.

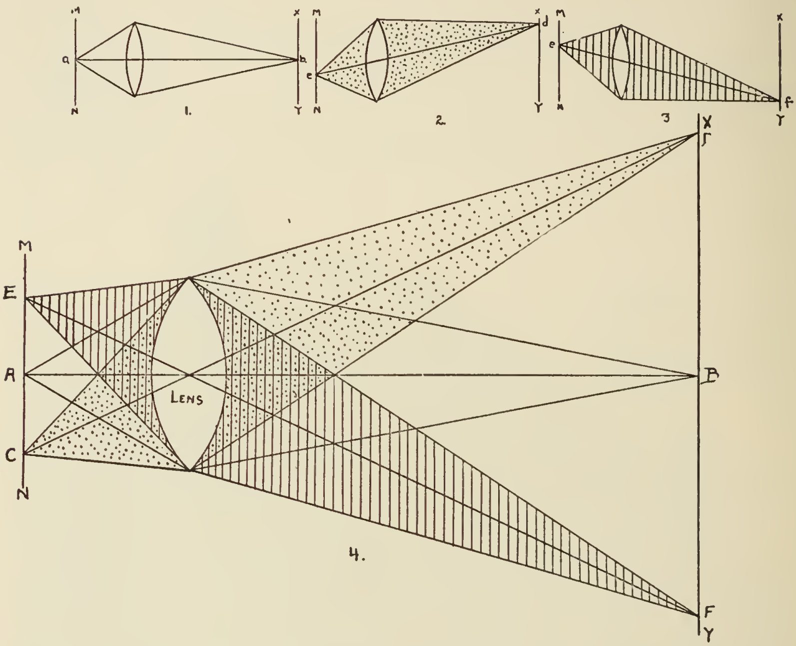


Light is reflected in all directions from a point in a surface. Thus from point A rays are reflected in directions 1 to 19 inclusive. A lens placed before this surface intersects rays 9, 10 and 11 at points C, M and D. The other rays do not have any effect upon the lens or film. The rays 9 and 11 are bent at points C and D and come to a focus together with ray 10 at point B. Passing this point they again diverge in directions indicated by E, F and G.

LIGHT.—We have already seen that light travels in straight lines—when it doesn't travel in a crooked one. The fact is that light travels in an approximately straight line only when its path lies through some medium of uniform density and composition. As soon as light leaves one medium such as air and enters another such as glass, it is bent to some degree, but as it is bent in a reverse direction when emerging from the other side of this medium and to a corresponding degree, the displacement is hardly noticeable. However, if the two sides of this medium are not parallel, then we do have a very apparent displacement of the rays which is apparent as a distortion of the image.

PRISM.—Most of us know that a prism will break an ordinary beam of light into its component spectral or "rainbow" colors. If we could twist this prism into a doughnut shape without the hole in the center we would have a piece of glass which would resemble two very flat, squat cones placed base to base. The same prismatic effect would persist but in a circular rather than a linear direction. If we now allow a beam of light to pass through this circular prism and fall upon a screen

of white paper, we will see one of the spectral colors as a spot, and around this in concentric circles, the other colors in their proper relation. As we change the distance between the screen and the circular prism, the different colors will occupy the central position in turn.



Mechanism of Image Formation. We have a surface XY in which three points are located (D, B and F). From each of these points a ray passes through the lens and is brought to a focus upon the film MN. Figure 1, shows the path of ray AB, Figure 2 shows ray CD and Figure 3 shows the path of ray EF. Figure 4 shows all three rays combined. We may assume that every other point in the surface XY is likewise reproduced in the plane MN. As the axial rays of these ray bundles follow a straight path passing through the center of the lens it follows that the image in plane MN will be inverted in relation to the position of the original in plane XY.

Lens.—This circular prism is the most primitive of all lenses.

If we grind down the apices of the cones and give both surfaces of the prism a spherical shape, we shall have the simple double convex lens, which we know as the "reading" or "burning" glass. This lens exhibits to a certain degree, the characteristics of a photographic objective or lens, but it exhibits so many faults that it is practically worthless for this work. We will

follow the development of the lens briefly by considering these faults and their remedies.

CHROMATIC ABERRATION.—This is a fault of the lens which causes it to separate the colors of white light just as we saw in the case of the circular prism. As objects are seen in various colors, it is evident that we must bring all colors to a focus at one point. Otherwise we get a diffused or "soft focus" picture. By combining a positive lens (one which is thicker in the center than at the edges) with a negative (one which is thinner at the center than at the edges) we accomplish our result. The positive lens brings light rays together, and the negative spreads them. This change of direction has a magnitude depending upon the refractive power of the glass, so by using glass of two kinds we can bend the converging rays outward just enough to compensate for the color dispersion and still have the rays meet in a common point or "focus."

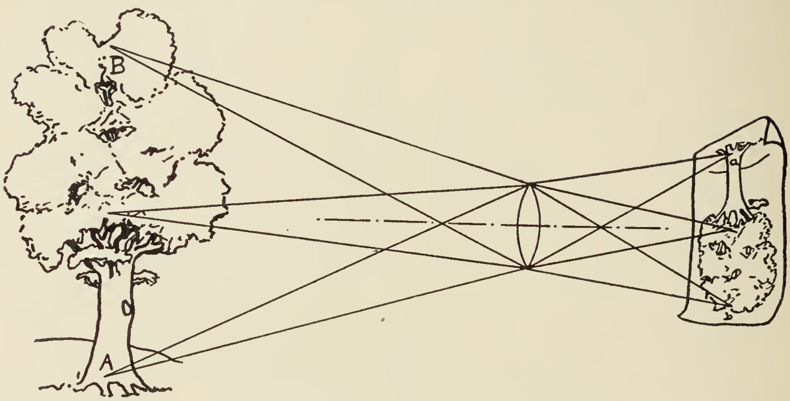
SPHERICAL ABERRATION.—The achromatic lens which we made by combining a positive and a negative lens, bends the rays more sharply at the edges than at the central portion. This again gives us a diffused image which is independent of color. By changing the shape of the surface from a true spherical curve and by adding a negative lens we can correct this.

CURVATURE OF FIELD.—The lens tends to give a saucer-shaped field. By further altering the curvature we can flatten this field so that a picture upon a flat film will be rendered sharp throughout its area.

LINEAR DISTORTION.—To overcome some of these faults we exclude the marginal rays by use of a shield which has a round hole pierced in it. This is the diaphragm. In modern lenses this diaphragm is adjustable and is known as the iris diaphragm. This makes straight lines bend in one direction or another depending upon its position before or behind the lens. By placing a lens on both sides of the diaphragm, we correct this and secure the rapid rectilinear lens, which has four times the speed and one-half the focal length of the corresponding simple lens.

RAPID RECTILINEAR LENS.—When the rapid rectilinear lens was developed, it was hailed as the ultimate in lens perfection. It placed in the hands of the photog-

rapher a lens of extreme speed, yet one which gave beautiful definition throughout the picture. At this time photography was limited to contact reproduction. Later on the small camera became so popular, due to its convenience in transportation and operation, that enlarging was changed from an experiment to a detail of everyday routine. With the popularization of en largement, came the discovery that the definition of the rapid rectilinear was sufficient only for contact printing. The enlarged prints showed that these lenses possessed vestiges of most of the primary aberrations, that



The manner in which the image of an object is formed by a lens is graphically shown in this drawing.

they did not possess an absolutely flat field and that they did not render both vertical and horizontal lines with equal definition. This last fault was due to a hitherto neglected aberration, namely, astigmatism.

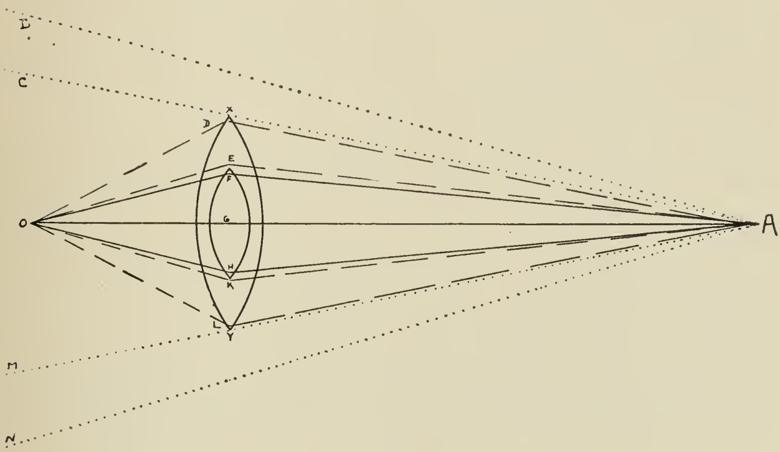
Anastigmat Lens.—After extensive research, and incidentally the compounding of an entirely new glass, a lens was made which had an extremely flat field, which was corrected for all aberrations to a much finer degree than the older lenses and which was fully corrected for astigmatism. These lenses would photograph printed matter in which the letters in the extreme corners of the plate were as sharp as those in the center. This new lens was known as the *anastigmat.*

The rapid rectilinear lenses were rarely made with a speed greater than f 6.5. and the usual speed was f 8.

The anastigmats were brought down to f 4.5 very shortly after they were perfected. This was hailed as a miracle, but since that time the formulae for the manufacture of these lenses have been perfected to such an extent that lenses of f 1.5 are now commercially available and lenses of f 1 have been made experimentally. By the use of a fluid cell a lens was once made which had the speed of f 0.5, but it had not, of course, anastigmatic correction.

Due to the fact that motion picture projection demands the utmost in enlarging, we need a lens which has been corrected to the last degree. Therefore it is essential that we use an anastigmat lens of the finest quality.

Finally, before leaving this discussion we should consider the subject of the "f" values or the comparative speed of lenses.



Speed of lenses. Given two lenses of the same focal length. The diameter of one is equal to EK the other to XY. Rays emanate in all directions from point A. The solid lines indicate the rays intercepted and focussed by the slow lens of small diameter EK; the broken lines indicate the rays focussed by the large diameter rapid lens XY while the rays indicated by dotted lines B, C, M & N are lost unless an even larger and more rapid lens is used. The speed of a lens of given focal length depends upon the diameter of the diaphragm (lens) opening.

Speed of Lenses.—We often speak of the speed of lenses. It must be evident that a bit of glass can have no inherent quality which enables it to crowd more light through itself than any other bit of similar glass. We find that the speed of lenses refers only to the diameter of the opening through which the light passes.

The larger this opening, the faster the lens ignoring losses due to reflection. One might say, then why not make a lens six inches in diameter and secure a lens with marvelous speed. This is all very well, but when that lens is completed we will find that it forms an image at a comparatively long distance from itself, and we are back at our starting point once more.

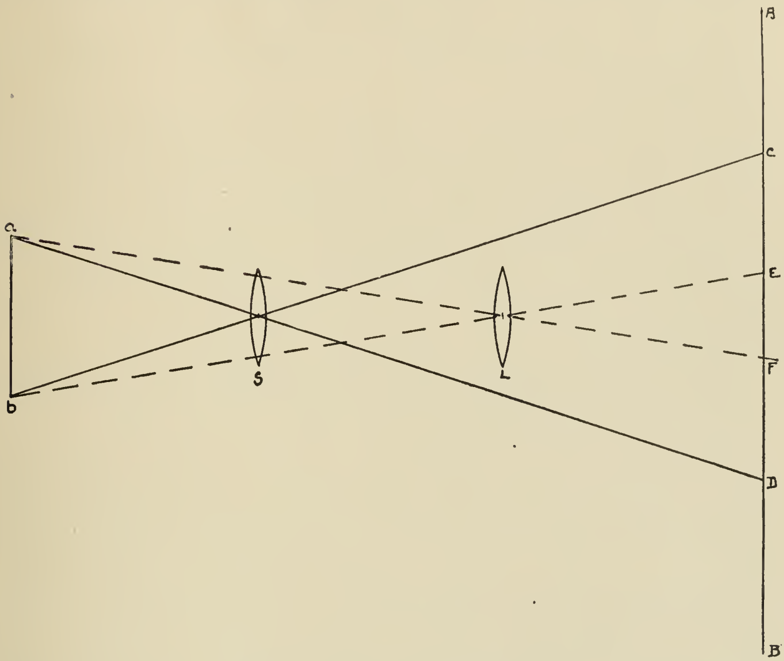
Thus we see that any factor which will indicate the speed of a lens must take into consideration both the actual diameter and the focal length of a lens. Now if we have a lens of six inch focus, such as we use for telephoto work in amateur cinematography, and we find that this lens has a diaphragm diameter of 1.5 inches, we divide the focal length by this diameter and we have 6/1.5 equals 4. Then we say that the lens has a speed of f 4. Likewise, let us suppose that we have a lens of twelve inch focus whose diameter is three inches, and a third one of three inch focus whose diameter is three-fourths of one inch. Similar calculations will all give 4 as the final result, so we find that these lenses, whose actual working diameter is ¾, 1½ and 3 inches respectively, all have the same speed, and all three would require identical exposures provided the same quality of film were used in each case, under identical lighting conditions.

The actual diameter of a lens is no indication of its speed unless we also know the focal length of the lens!

In trying out these calculations with your own lens, remember that the diameter of the lens opening is measured with the two elements of the lens in place. This gives a slightly different result than measuring the actual diameter of the diaphragm. This apparent diameter indicates the *effective aperture* as compared with the *actual aperture.*

Focal Length.—Every lens used in motion picture photography is marked with its focal length. This focal length is the distance from the optical center of the lens to the surface of the film when an object at a great distance is sharply focussed. The reason for the use of lenses of various focal lengths is not clearly understood by many cinematographers. For the sake of illustration, let us consider the usual one inch lens as the standard for sixteen

millimeter use. This we may call the "eye" lens, giving us a scene about as the eye sees it. Then suppose that we go to a ball game, and we take a pair of low power binoculars with us. These binoculars aid us in seeing certain details which we should otherwise miss. If we also take the camera we will equip it with a four inch lens which



FOCAL LENGTH OF LENSES

Objects in plane AB are focussed upon plane ab by short focus lens S and long focus lens L. The short focus lens S gives an image of field CD upon focal plane ab while long focus lens L gives an image of the small field EF on same size focal area ab.

corresponds roughly to our low power glasses. That is, with this lens we get an image which is four times as large, lineally, as with our one inch lens. Finally, we go to the races with a six power glass, and to secure a corresponding film we make use of a six inch lens, which gives us an image six times as large, lineally, as the one inch lens.

The greater the focal length of the lens the larger will be the image upon the film!

LENS ANGLE.—This brings up the question of the lens angle. This angle is easily determined. We know

that we have an aperture base of 10.5 millimeters. (In fact the diagonal should be used, but for practical purposes, the base gives us a more valuable working basis) If we use a lens of 25 millimeter (1 inch) focus, we have the determinate elements of a triangle, the base of which is 10.5 millimeters and whose altitude is 25 millimeters. By constructing this triangle we find the lens angle which is identical with the included angle at the apex of this triangle. (For table of lens angles see Appendix.)

If we use a lens of two inches focal length, we find that as the base is unchanged, the angle becomes much more narrow. As it is evident that everything included between the legs of the corresponding exterior angle will fill the frame from side to side, it follows that,

The narrower the angle of the lens the larger will be the image of any given object at a given distance from the lens.

The angle of the 25 millimeter (1 inch) lens used with sixteen millimeter film includes an angle of approximately 21 degrees on the base of the frame.

The usual sixteen millimeter camera comes equipped with a lens of twenty-five millimeters focal length, and ranging from f 6.5 down to f 2.7 in speed, the usual speed being f 3.5. The average camera owner will continue to use this lens for some time, and in fact it is better for him to use it in making the first four or five spools of film. By the time four hundred feet of film have been exposed, developed and projected, the cinematographer should have a fairly definite idea of the action of various lighting effects, whether natural or artificial. He will have become used to the operation of the camera, and he should have become used to the manipulation of a good exposure meter.

There can be no doubt that the use of one lens for all purposes soon gives a familiarity which enables one to secure a satisfactory exposure with almost any subject. This 25 millimeter lens has been adopted for amateur use because it has that focal length which gives the most natural perspective when the pictures are projected upon the screen, under average, normal home conditions. This lens will re-create scenes in such a manner that the scene

as the eye saw it will be practically duplicated, with the limitations imposed by the shortcomings of the photographic process, of course.

For this reason the 25 millimeter lens is the nearest approach we have to the ideal universal ciné lens for sixteen millimeter film. It is the lens which will be habitually used for vacation films, casual shots and perhaps half of the serious work undertaken by the advanced amateur. However, this must not be taken to mean that this lens should be the only one ever used. The amateur who limits himself to the use of one lens, no matter what that lens may be, is losing ninety percent of the pleasure which may be secured from motion picture photography. The use of any one lens induces a monotony of treatment which not only becomes tiresome to the cameraman, but it also results in a film which is trying for the spectators. In order that a set or "battery" of lenses may be selected intelligently, we should consider, first, the various classes of lenses, and then the individual examples of each class.

We will of course assume that the lens to be used in cinematography shall be an anastigmat. To this there is the one exception of the soft focus lens, but besides that one we shall consider only the finest lenses available, the fully corrected anastigmat.

Lens Classification.—These lenses may be classified in two ways, first according to their individual maximum apertures and second, regarding their focal length. We have lenses whose maximum aperture is as high as f 1.5, and experience teaches us that rarely can we use an aperture smaller than f 16. Moreover experience has taught us that we should have available a range of exposures which bear the ratio of about eight to one, and as we have no adjustable shutter, we must have a range of diaphragm apertures whose areas vary from one to eight. If, then, f 16 is the smallest practical aperture we must use one whose f value is about eight times this. We have seen that the speed of lenses varies inversely as the squares of the f values, so we have 16 x 16 equals 256. One-eighth of 256 is 32. The square of six is 36 which is near enough. Thus our maximum aperture should be at least f 6. We will

find the slowest lenses used on high grade cameras will have maximum apertures ranging from f 7 to f 6, usually about f 6.5. The amateur will rarely want to use any larger aperture than this, when shooting exteriors under normal light conditions.

While considering the f values of lenses we might pause to consider this fact. *One lens working at a stop of f 8 is no faster than any other lens set at the same stop, regardless of their relative maximum apertures!* This means that the finest anastigmat made, when set at f 16 is not one bit faster than the lens in your two dollar Brownie camera.

This statement, notice, pertains to speed only. The fine anastigmat correction remains in the better lens, and this is a consideration entirely separated from the consideration of speed as we shall see later.

> Some modern lenses are advertised as being "brilliant." This is a little understood but vitally important point. No piece of glass will transmit 100% of the light which falls upon it, a certain amount of light is lost through "absorption," and a far greater amount through reflection. Thus we have lenses which transmit 90% or more of the light which falls upon them, while other lenses, although of the anastigmat class transmit less than 40%. We can see that if two lenses, both working at f 4.5, be used under identical conditions, one transmitting 90% and the other 45% that the results will be that of two lenses of equal brilliancy, one working at f 4.5 and the other at 6.3. For this reason it is essential that only lenses of the best quality be used.

We find that lenses naturally fall into four sub-classes in regard to speed, ultra-rapid, rapid, normal and slow. The ultra-rapid lenses include those whose speeds vary from f 1.5 to f 2, such as the f 1.5; f 1.8; f 1.9; f 2.0. These lenses will give a full exposure to normal film under unbelievably adverse lighting conditions.

Ultra Rapid Lenses.—As it has long been accepted as a basic law in applied optics that any anastigmat lens shall be as free as possible from all faults or "aberrations," the design and manufacture of such lenses has been very dif-

ficult and this difficulty has increased in almost geometric progression with each new and larger aperture attempted. The first lens of this type, an f 1.9 was a serious offender. It was generally well corrected but it had a very bad and non-uniform chromatic aberration of such a character that a sharp visual focus could be obtained, upon one plane, but the blue focus, the active chemical focus was in a quite different plane. The result was that, unless this difference between the visual and chemical foci was compensated, there would be a bad out-of-focus blur upon the exposed film. This fault was soon overcome, this lens now having fully satisfactory correction.

It was found to be a practical impossibility to make lenses of such extreme speed without some residual aberrations, but these were minimized to such an extent that for all practical purposes these extremely fast lenses are as good as other anastigmats. However, before saying anything more about them, it would be well to designate just what the "softness" is which the slightly undercorrected lens gives. Compare any ordinary amateur snapshot, made with a camera having a fixed focus lens, with a photograph made by a commercial photographer for purposes of reproduction. The amateur print is pleasing, if good at all, while the professional print has a wiry sharpness of detail almost as though the details had been cut from paper and pasted to the background. The amateur print is soft while the professional print has the utmost of anastigmatic definition. The softness referred to must not be confused with the fuzzy "soft focus" work so popular with pictorial workers. This softness due to residual aberration is so slight that it will never be noticed when viewing the projection of the film.

Residual Aberration.—Residual aberration may have either of two effects, one is the softness which has just been fully described but which is not visually or directly perceptible, but which makes itself known in giving a general smooth, blended appearance to the image, while the other gives a duplication of the image which markedly resembles the double image secured when the camera is moved slightly. This subject cannot be gone into more deeply at this time, but for fur-

ther information and diagrams the reader is referred to the excellent address given by Doctor R. Thun of Berlin and published in "Kino-Technik." The reader may be able to secure reprints from the Hugo Meyer Optical Company of New York.

The central portions of fast lenses are ground as accurately and corrected as highly as in any fine anastigmat, but the difficulties arise in properly grinding the periphery and such residual aberration as may be found in a lens arises from the aberration of the peripheral rays. It follows then, that if a smaller stop is used with these lenses and only this central portion of the lens used, that the lens will be equal to any lens. This is true, but to a certain limited degree.

Let us consider as a concrete example the most rapid lens obtainable on the open market to-day. This is the Plasmat, a creation of Doctor P. Rudolph who gave us the Protar, the Tessar, the f 4 Plasmat and finally the f 1.5 Plasmat.

The experiments of Dr. Thun of Berlin led him to state that at apertures of f 3.5 and smaller, this lens gives as fine quality as any lens made, and at f 1.5 it gives a definition which is soft but not to a perceptible degree, which in turn gives an actual working depth of focus almost equal to that of an f 2.7 to f 3 lens.

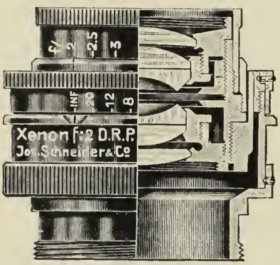
Here we have a decided advantage. Optical law states that with the increase of aperture we have a decrease in the depth of field. This is true, but by using a lens which gives a slight softness, this softness is not visible as apparent fuzziness or distortion, yet it results in the extension of the depth of field to a remarkable degree.

This may be slightly technical, but with all of the present confusion regarding these extremely fast lenses, the amateur should know just what they will and will not do. We may accept it as axiomatic that the larger the aperture the less highly corrected any lens will be, and also that the quality of a lens of this type is not to be judged by the presence or absence of faults, but the way in which such faults are distributed throughout the lens to disguise their presence. A fault which is not apparent is practically non-existent.

And now, just what will such a lens do? The ultra-rapid lens is made for the express purpose of securing an exposure when, without it, there would not be sufficient light. This does not limit the usefulness of this lens to night work by any means.

In the ordinary well lighted interior it is possible to make motion pictures with an f 1.5 lens without the aid of artificial light. This is practically impossible with the f 3.5 lens. This in itself opens up an entirely new field for the amateur. Again, we often find ourselves confronted with landscapes of such nature that we should like to use a heavy filter, but we cannot because of the loss of light incurred. With an ultrafast lens, such filters may be used whenever desired. Then, we often find ourselves in glades and ravines where the light is dim and has a distinctly greenish hue. Such a light is particularly bad for photography, but with the compensation afforded by the ultra fast lens we may make exposures with assurance of success.

The amateur is constantly confronted with scenes which for one reason or another he cannot photograph, usually the fault being the lack of a sufficient quantity of the proper kind of light. The extremely rapid lens will allow him to secure most of these shots.



(*Courtesy Burleigh Brooks*)

A cross section showing the construction of a modern fast anastigmat lens. As lenses of such extreme speed require careful adjustment, this lens is provided with an adjusting collar by means of which any lens may be individually adjusted to the camera with which it is to be used. This adjustment does not interfere with the interchange of lenses.

The recent rapidly growing interest in slow motion and interior cinematography has given rise to a demand for a fast lens which is not a special purpose lens. The amateur wants a fast lens which he can leave upon his camera permanently and use it at the smaller stops for usual work

as well as for high speed work. It has been pointed out that this is a very difficult combination to secure. In fact it is so difficult that the combination speed and all-purpose lenses, such as the Schneider Xenon, have been given the perfect correction necessary for all-purpose and all-stop work only by sacrificing a little of their maximum speed. They have maxima of about f 2, which is, practically speaking, about as fast as the f 1.9 lenses. They are fully corrected for use at any aperture and will compare favorably, stop for stop, with any ciné-anastigmat while giving ample speed for dark days, heavy filters, slow motion and interior work.

Rapid Lenses.—The medium rapid class of lenses which range from f 2.5 to f 3 are really no more than normal ciné anastigmat lenses rendered somewhat more efficient. The f 2.5 lens has a speed about twice as fast as the f 3.5, and the others such as f 2.7, f 2.9 and f 3 a steadily decreasing speed. The f 3 requires only ¾ of the exposure required by the f 3.5. These lenses have a very slightly lower degree of correction than the f 3.5, so that they may be regarded as highly efficient normal lenses of slightly less than usual quality.

Normal Lenses.—The normal class is represented by the lenses of values f 3.5, f 3.8, f 4 and f 4.5. These lenses are the speed usually found on ciné cameras, the f 4 and f 4.5 being used for the lenses of longer focus, while the shorter lenses usually have a speed of f 3.5. They are highly corrected and film made with these lenses will show the actual silver grain before they will show any loss of definition due to poor lens quality.

The most highly corrected lenses which we have in general use are very slow, having speeds of approximately f 9 or f 10. These lenses are used by photo-engravers who make plates for three color printing. Perhaps the most highly corrected photographic lenses for general use are those types known as the Protar and Dagor types. These lenses give a very sharp definition when properly handled. The f 3.5 cine lenses do not give such needle-sharp definition but they are highly enough corrected to give perfect satisfaction, even in the exacting work of studio production.

Therefore, the amateur who uses a high grade ciné anastigmat of f 3.5 has the satisfaction of knowing that he is using the best obtainable lens of its speed, and the same lens that is used in professional studio production.

Thus we have seen the need of the ultra fast lens and of the standard speed lens. The ownership of these two lenses will enable the cinematographer to secure almost any film he may want, but not quite every one. To understand the shortcomings of this two lens battery, we shall take up the question of the proper focal length of lenses for cinematography.

(*Courtesy Bell & Howell*)

The image secured with a 1" lens. *The image secured with the 3" lens.* *The image secured with a 3¾" lens.* *The image secured with a 6" lens.*

The effect upon the image secured with the 16 m/m camera when using lenses of various focal lengths as indicated. This clearly demonstrates the value of long focus lenses in amateur cinematography.

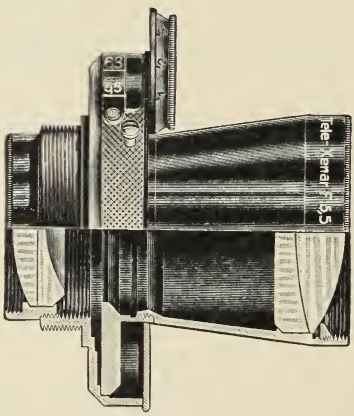
Focal Length.—In this discussion it is well to remember that the focal length of the lens has but a slight direct bearing upon its speed. For mechanical reasons as well as optical, the longer focus lenses are usually slower than the short focus lenses.

As has been pointed out, the longer the focus of the lens, the larger will be the image, and the less extensive the field of view.

It may be assumed that the linear enlargement secured with any lens is in proportion to the ratio existing between the focal lengths of the lenses in question. Thus we find that the one inch lens used with sixteen millimeter film embraces an angle of approximately 21½ degrees while the two inch lens used with the same film embraces an angle of about 11 degrees. (The angles given are for the base of the frame and not the diagonal.) It is evident that if we extend these angles that at any given point the larger angle will subtend a

perpendicular just twice the length of that subtended by the narrower, or in other words, the narrower angle will give an image twice the size of that given by the wider.

It would seem then that all that is necessary to secure any size image desired is to mount the corresponding lens on the camera and shoot. Unfortunately it is not as simple as that. In the first place we must remember that any ordinary photographic lens must be placed in front of the film a distance at least equal to the focal length of the lens. In addition to this the absolute diameter of the lens increases with the focal length, so that we soon have a lens whose long extension and weight make its use prohibitive. Aside from this we have certain optical difficulties imposed by the long focus lens. For these reasons, six inches is about the limit for ordinary lenses when used with substandard motion picture cameras. Even this is so inconvenient that it has been largely superseded by the six inch telephoto lens.



(Courtesy Burleigh Brooks)

Lenses which give increased focal length without the corresponding increase in physical length are known as "Telephoto" lenses. The cross section above shows the construction of such a lens.

There seems to be some confusion regarding the use and meaning of the word telephoto. A telephoto lens is a particular lens design, and not merely a lens of longer focus than normal for the use to which it is placed. The telephoto lens has a focal length of (usually) about twice its actual mount length. This short-

ening of the physical body of the lens is made possible by the introduction of a negative lens element which disperses the converging rays to a slight degree.

A six inch telephoto lens will give the same sized image as a regular six inch lens.

The purpose, then, of the long focus lens is obvious. It is made to enable us to secure larger images at any given distance from our subject. The six inch lens will have about the same effect upon the sixteen millimeter camera that a six power prism binocular has upon normal vision.

LONG FOCUS LENSES.—Lenses of longer focal lengths than the normal, do not fall into natural groups as they do when considered in relation to their relative speeds. The focal lengths progress almost without break by inches, with many makers offering fractional inch differences, thus we may have 3 inch, 3¼ inch, 3½ inch and 3¾ inch. For practical work only three focal lengths are necessary, for example the one, the three and the six inch. These will secure anything you will want.

(Courtesy Bell & Howell)

When using the longer focus lenses on the Filmo Camera the field of the original finder is obscured. The extension unit makes possible a clear and unobstructed view even when using the largest lenses.

The use of the telephoto or long focus lens requires a little practice. We will find that any unsteadiness of the camera is magnified with the magnification of the image. For most persons, then, the limit of focal length of lens for the hand held camera is two inches. For greater focal lengths, by all means support the camera upon a tripod. By using a tripod, a perfect film may be obtained, even when using a six inch lens.

When using lenses of focal length greater than usual, it is necessary to make use of some kind of masking finder. Otherwise the subject will almost invariably be allowed to pass out of the field of view, for the field of the six inch

lens is unbelievably small, the included angle being less than 4 degrees. It is equivalent to using a 150 inch lens with an 8 x 10 camera.

The uses of such a lens are obvious. In making films of wild animals, birds and in all similar work the long focus lens is absolutely essential, and also in making shots of public events where close approach to the subject is prevented by crowds. Travellers find such a lens invaluable in "stealing" shots of scenes from such a distance that the camera is unnoticed, and in many similar circumstances.

Such lenses as these have considerably less depth of focus than the lenses of shorter focal length, so it is necessary to focus them with extreme care. In fact, more care in focussing with any lens will result in an improvement of the quality of the films produced which will be surprising. There are two ways in which this can be accomplished.

Distance Meters.—In the first place, the cinematographer may make use of a distance meter or range finder such as the Leitz Fodis range finder or the Zeiss-Ikon Goerz distance meter. These meters work on the rocking prism principle and are accurate to within 5% or less, and in practically every case this amount of error, which is equivalent to a trifle more than one-half inch per foot, will be compensated by the inherent depth of focus of the lens. In looking at the subject through one of these meters, the details are seen in duplicate. By bringing these details into proper coincidence, the distance of the subject is determined. These meters have been described fully in Chapter Three.

When the distance has been determined by the use of the distance meter the lens is focussed to correspond by means of the focussing jacket. With high grade lenses, the calibration may be depended upon as being absolutely accurate, and exposures made in this manner will be absolutely correctly focussed.

Direct Focus.—Professional cameras are equipped with a device which enables the operator to see the actual image through the camera lens, just as it will appear upon the film. This enables the focus to be determined visually,

1. The Goerz reflecting focussing device with the 6¼" Telestar lens in place on Victor camera.
2. Focussing with the reflecting focussing device.
3. The home fernery supplies a suitable background for insect "closeups" with the 6¼" lens and extension tube.
4. The Goerz set makes possible the use of professional diffusing masks which add greatly to the film.

and at the same time, the arrangement of the subject in the field is likewise assured, and no danger of poor arrangement due to lack of coincidence between fields of the finder lens and camera lens. Unfortunately the camera manufacturers have not seen fit to make such provision on the amateur cameras, despite innumerable demands on the part of the amateurs. This is one of the most serious faults of the modern amateur ciné camera, and one which has been overcome due to the engineering skill of the C. P. Goerz American Optical Company.

The Goerz reflecting focussing device attaches to the camera in the usual lens mount collar. The lens is then attached to the outer end of the barrel of the device. This focussing device is equipped with a sliding, total reflection prism, and a high power microscope. When the prism is in place behind the lens, the image is presented to the eye just as it will appear upon the film, and magnified to such an extent that it may be easily focussed with the utmost accuracy. At the same time the arrangement of the subject in the field is made. When this is done, the prism is moved to one side. This leaves the light path entirely unobstructed and at the same time closes the side opening absolutely preventing any fog from this source. This little device is indispensable for the scientific worker and others who use long focus lenses extensively. A further use of this device in low power photomicrography will be explained in another chapter.

This accessory is small and attaches to the camera in an unobtrusive manner. One of its features is that the operator using this device looks into the tube from the side, so that the camera may be focussed upon a subject whose position is at right angles to that of the cinematographer, making "stolen" shots easier than ever.

Thus far we see that success with any lens is assured if we (a) give proper exposure as indicated by a reliable exposure meter (b) focus the lens properly according to the reading of a reliable range finder or by direct vision, and (c) if we arrange the subject matter properly in the frame. In order to accomplish all of these aims we need the instruments mentioned as well as the reflex focussing

device. Sensible accessories are good investments and pay high dividends in the way of vastly improved results, but the cinematographer must learn to differentiate between the necessary and well designed accessory and the fancy but impractical "gadget."

FILTERS.—Manufacturers have been urging the use of filters or color screens. The most common and the almost universal sales argument is that the filter will "get the clouds." Now why it is so vitally important that the clouds should be "got" is a deep mystery. True, the sky which has the proper tonal values will reveal any existent cloud forms, but the presence of the cloud is only a symptom and not the disease—than which no simile could be more inapt. There should be a full understanding of the uses and abuses of the color screen on the part of every amateur, but to discuss this, even briefly, necessitates the exposition of more theory. The writer sincerely trusts that the practical reader is not becoming bored with these technical phases of the work—which mean so much in the matter of successful cinematography.

THE SPECTRUM.—Like Gaul, our spectrum is divided into three parts, the super-visible, the visible and the sub-visible, known more commonly as ultra-violet, visible daylight and infra-red light. With the infra-red we are not concerned, but we shall devote our entire attention to the other two. Daylight is—daylight, known universally, and indescribable beyond the statement that it is composed of a mixture of all known visible color. The ultra-violet is not in any basic way different from daylight except for the insignificant fact that we cannot see it nor see by its illumination. (The latter statement is subject to some exceptions which have no bearing upon this work).

We recall from our schooldays that the sensation of color is caused by the different vibratory rates of those etheric waves which we call "light." The red is a slow, heavy-waved color, while the visible violet is a thing of delicate waves moving very rapidly. The ultra-violet is the same as the violet but more delicate and having a more rapid vibratory rate. There is reason to believe that it is the actual vibration which affects the sensitive

film rather than that vague quality which we call luminosity. At any rate, we find that the shorter and more rapid waves affect the sensitive material more quickly than do the slower waves. The most photographically powerful visible color which we have is the highest visible blue, while as we ascend the scale we find the ultraviolet vibrations growing more and more powerful, photographically speaking. *It so happens that the chemically active, or photographic, rays overlap the visual rays in the blue region.*

We know that all colored objects are photographically rendered as black, white or some shade of intermediate gray. We find that the depth of the gray tone is directly proportional to the position, in the spectrum, of the color of the original. Thus red photographs as almost pure black, while blue gives us, photographically, a much softer, more attractive white than does white itself! We should then expect yellow and green to be represented as medium gray. This is true, although they are rather more dark than light gray.

PANCHROMATIC FILM.—With the improvement in emulsion making, chemists have succeeded in making the sensitive material respond to lower and lower vibrations, and this means that where the original emulsion was almost totally blind to every color except blue, we now have in our common emulsions a material which will react to colors as far down the scale as yellow, and with some specially prepared emulsions, we get a reaction to every visible color! This latter type of emulsion is known as panchromatic.

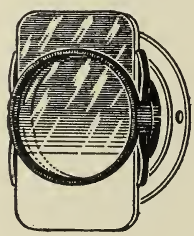
Laboratories for film processing—the old time "darkrooms" were illuminated by red light, because the red light had almost as little effect upon the emulsion as no light at all, but when we sensitize the emulsion to red light we render the old "ruby-light" useless. This panchromatic film must be developed in total darkness, or a very dim green light. Why green, when it is so much higher up the scale than red? Because the eye can see by the aid of a smaller amount of green light than of any other single color.

What of this, in amateur cinematography? *Correct*

tonal values! Imagine a young lady clad in a bathing suit ornamented with broad bands of scarlet and blue. No, better yet imagine the entire suit scarlet, with edging and trimming of blue. The red is bright while the blue is subdued and cold. Make a photograph of this young lady and examine the result. The suit is dark with a light colored edging. You have, to all intents and purposes a negative! Yet we have become so accustomed to this effect in photographs that we accept it as truthful!

One of the principal beauties of a landscape is the pure blue of the sky, delicate and softly blended in various tones, with perhaps a wandering cloud form and perhaps without. We snap this with our Brownie or with our movie camera either one, and we get a sky which in most cases is a bare expanse of blazing, distracting *white.* What would you think if you were to venture forth some day and see a sky the color of a cafeteria table-top?

Now why is this true? As we have said the modern film is sensitive to colors as low as the yellow. This is true, but the sensitivity drops with each color and "fades out" in the yellow. The blue acts far more quickly than the others. If we give sufficient exposure to get some of the higher green, the blues have burned up their alloted portion of the emulsion on the film and this gives us pure white in the positive. Remember the more active any color, the lighter it will be represented in our film.



(*Courtesy Burleigh Brooks*)

The amateur should use a good filter upon every possible occasion as its use will inevitably result in better films. One of the most serviceable filters is the graduated filter such as is shown here. This is the Ramstein filter.

Color Values.—In order to allow the yellow and green rays to act without having the blue rays overdo their work we must erect a gate before our lens which will let the

yellow and green pass easily but which will hold back the blue and only let it seep through. This gate we call a "filter" because it filters out the blue. In fact filters are made which filter out every bit of the blue but, this is too much for average work. We don't want our blues to be represented as black, only as a medium gray. So we use the ordinary yellow filter.

As the blue rays are the most powerful, they will affect the emulsion in less time than the other colors will. Then if we cut out the blue rays we must admit enough of the yellow rays to pass to expose the film. Suppose that we found our meter to indicate f 8 as the proper diaphragm setting, but after that we decided to use a heavy yellow filter which cut off so much blue that it required four times as much of the filtered light to affect the film. This filter would be marked 4x and we would use a stop of f 4 which is 4 times as fast as f 8. *The filter adds nothing. It merely removes the too active blue rays.* It follows that if some light is taken away and none added that the exposure must be increased. *All filters require some additional exposure.*

(*Courtesy Wollensak Optical Co.*)
Solid color filters are often mounted in cells which slip over the lens mount or screw into it such as this one.

Then what happens? The blue seeps through and affects only a part of the sensitive material, but the white of any clouds in the sky contain both blue and the other colors and the whole bombards the film and affects practically all of the sensitive material. Yellows and green affect the film somewhat and as a result we find our landscape film shows a sky having a delicately blended gray tone with the white cloud forms easily apparent, but we also note that all other color values are far more truthfully rendered. It is this latter fact that lends so much charm to filtered negatives. While we do not consciously notice the true reason,

we instinctively recognise the reproduction as being more nearly true to nature and we have carelessly attributed it solely to the "clouds showing in the sky." Do not mistake me. I do not underestimate the beauty of the wonderful cloud forms, but there are other reasons.

(*Courtesy Burleigh Brooks*)
A landscape taken without the aid of a filter.

(*Courtesy Burleigh Brooks*)
The same scene taken with the aid of a filter.

There is hardly a subject which will not be rendered more attractively with a filter! Get the habit of using it all the time. Secure a full set of filters, 2x, 3x and 4x.

You cannot always use them, for there will be times when there is insufficient light. Even then you can at times use the graduated filter which does not filter the dark foreground and which gives the greatest filtering effect upon the higher sky portion. By all means add the graduated filter to your set. And above all else secure the best possible filters. A cheap filter will ruin the correction of the finest anastigmat lens ever made! If you use a cheap filter made of "wavy" glass you might as well use window glass lenses!

The filters used should be made of glass colored to the proper depth. This glass should then be ground optically flat. Such are the Goerz, Ramstein and similar high grade filters. The graduated filters of this class, such as the widely known Ramstein, are made by cementing together a yellow and a clear strip of glass and then grinding this obliquely giving a physical wedge of yellow glass upon a colorless support. Such filters will not injure the lens correction.

There are times when the need of a filter is felt to the Nth degree. But there may not even be enough light to use the unscreened lens. Then you feel the need for a high aperture lens. You cannot afford to be without a lens of f 2 or faster speed. The f 1.5, f 1.8 and f 1.9 lenses are often worth their whole cost in securing a single shot, and then, with this equipment you can filter almost every shot.

The amateur who uses the high aperture, heavily screened lens would not part with the combination any more readily than he would part with his camera!

There are a few other accessories which are not strictly optical in their nature, yet which are used to supplement the lens effect and for that reason will be discussed here.

Iris Vignetter.—The iris vignetter is similar to the iris diaphragm in the lens, but it is larger and situated about two inches in front of the lens. When this iris is operated during the camera operation it gives a screen effect which appears as though the screen were covered with a black curtain in which a constantly decreasing, circular opening allows the picture to be seen. This is used for various pictorial effects, for "framing" shots, for pointing out cer-

tain individuals, for opening and closing sequences and a great number of other uses. It is very often used in those places where the fade would be used in professional work.

(Courtesy Bell & Howell)

The Filmo iris is equipped to take a filter in the manner shown. Other irises make use of the filter in various ways. The Goerz devices have ample room for the full size filter in the mask slot of the mask box.

Mask Box.—The Goerz mask box is a rectangular frame situated about ten inches in front of the lens and connected to it by means of a long funnel-shaped attachment. This "frame" is so arranged that "masks" may be inserted in the frame. These masks are cut from black celluloid or black cardboard. They have openings of various shapes cut out and these shapes are registered upon the film. Thus if a circular opening is cut through the mask, the film will show the picture in a circle upon the screen. This circle will have diffused or "soft" edges. If we photograph a dining table which includes a polished carafe and then make a mask which allows only the carafe to be seen we can by a subsequent exposure through this mask photograph a girl who will apparently be confined within the carafe. This is a form of work which will be discussed more fully in the chapter devoted to trick work.

By making special effect masks upon film, many professional effects may be secured which would otherwise be unobtainable, and the mask box may also be used for supporting filters.

The mask box is also used for making titles by an ingenious method which will be explained fully in the chapter devoted to title work. In fact, the mask box, the outside iris and the reflex focusser are invaluable to the amateur who really wants to do high class work. The time

1. The camera set up with the complete Goerz effect set, showing focussing microscope.
2. Operating side of same equipment.
3. Focussing the lens with the aid of the focussing microscope.
4. The outfit in use.

has come when amateur films can be made to rival the professional ones in quality, and it is strictly up to the amateur to see that his films are of the best.

For the benefit of those amateurs who have certain favorite lens makers a short and partial list of amateur ciné lenses is appended. This list is not, cannot be complete, for no doubt lenses will be introduced between the time of this writing and the publication of this book. There are, too, no doubt, lenses of which the writer has no knowledge, for he who knows every lens which is produced, even in this country alone, has a tremendous amount of information at his disposal. Standard ciné lenses and still camera lenses are not considered. Only such lenses as have been adapted to the substandard cameras are listed.

THE WOLLENSAK LENSES

f 1.8	25 m/m.	The Wollensak ultra fast lenses for slow motion and deep filter work. These lenses are supplied regularly on Victor cameras at slight additional price
f 1.8	50 m/m.	
f 2.5	25 m/m.	Medium fast lenses
f 2.5	50 m/m.	
f 3.5	25 m/m.	Standard 16 m/m., ciné lenses
f 3.5	50 m/m.	
f 3.5	25 m/m.	Verito—The famous Verito soft focus lenses applied to the substandard ciné camera
f 3.5	50 m/m.	Verito
f 4.5	75. m/m.	Medium power telephoto lens.
f 3.3	3¾ inch	—medium power, slightly greater magnification and speed than the f 4.5, 75 millimeter
f 4.5	6 inch	—High power telephoto lens

THE GOERZ LENSES

Hypars

f 3	16 m/m.	The widest angle lens available for amateur cameras
f 3	25 m/m.	The standard amateur ciné lens

f 3	1⅜ inch	Slightly long focus
f 3	1⅝ inch	Slightly long focus
f 3	2 inch	Medium long focus
f 3	3 inch	Long focus
f 3	4 inch	Long focus
Hypars f 2.7		
f 2.7	2 inch	Somewhat faster than f 3 same length
f 2.7	3 inch	Somewhat faster than f 3 same length
f 2.7	4 inch	Somewhat faster than f 3 same length
Cinegors		
f 2	1⅜ inch	Ultra rapid
f 2	1⅝ inch	Ultra rapid
f 2	2 inch	Ultra rapid
Dogmars		
f 4.5	4⅛ inch	Long focus
f 4.5	5 inch	Extra long focus
f 4.5	6 inch	Extreme long focus
Telestars		
f 4.5	4⅛ inch	Low power Telestar telephoto
f 4.5	6¼ inch	Medium power telephoto
f 4.5	9½ inch	High power telephoto
CARL ZEISS LENSES		
f 2.7	25 m/m.	Usual substandard lens
f 3.5	35 m/m.	Considerable enlargement over the 25 m/m. lens
f 3.5	50 m/m.	Medium power telephoto
f 4.5	150 m/m.	High power telephoto
COOKE LENSES		
f 1.8	25 m/m.	The Cooke high speed lens
f 3.5	25 m/m.	Usual focal length
f 3.3	3¾ inch—	Medium power telephoto lens
f 4.5	6 inch—	High power telephoto lens
DALLMEYER LENSES		
f 1.9	25 m/m	Dallmeyer high speed lens
f 1.9	50 m/m.	High speed, long focus
f 4	4 inch—	Medium power telephoto lens
f 4.5	6 inch—	High power telephoto lens

SCHNEIDER SERIES

f 2	25 m/m.	Speed and all purpose
f 2	35 m/m.	" " " "
f 2	50 m/m.	" " " "
f 1.8	75 m/m.	" " " " and long focus
f 1.8	105 m/m.	" " " " " " "
f 5.5	7 1/8 in.	Tele-xenar, with 3½ in. extension
f 5.5	9½ in.	Tele-xenar, with 4¾ in. extension
f 5.5	10 5/8 in.	Tele-xenar, with 5¼ in. extension

MEYER PLASMAT SERIES

f 1.5	20 m/m.	Slightly wide angle
f 1.5	25 m/m.	Usual focal length
f 1.5	1 3/8 in.	—Slightly long focus
f 1.5	1 5/8 in.	—Slightly long focus
f 1.5	50 m/m.	Long focus
f 1.5	75 m/m.	Medium power telephoto

For tables and other optical data of a practical nature the reader is referred to the appendix.

CHAPTER SEVEN

THE MOTION PICTURE TITLE

There have been many arbitrary classifications assigned to motion picture titles, but the professional usually recognises only three, the main title, which is a group, the subtitles or captions and spoken titles. This classification may serve us as well as any other. If we go into the matter of explanatory titles, descriptive titles, emotional titles, expansive and explosive titles we shall become inextricably confused. This would be absurd as the purpose of the motion picture title is to eliminate confusion.

That the motion picture is infinitely superior to the written or spoken language is self evident. That it can present subtleties and detail beyond the power of words to express, is well known, but the fact that words are generalized in import gives the language of the title a power which the actual picture can never usurp. We flash upon the screen a title bearing the words "Twenty Years Later." There we have a definite statement which could have hardly been presented through the medium of the picture itself. For the utmost in the transmission of ideas then, we find a combination of the title and the picture, almost ideal.

Too often we find a picture either written, directed or edited by some individual who has not been able to break the language habit. Such films consist merely of illustrated titles. The writer has actually seen films in which more than half of the reel was composed of titles! Better, far better a film without titles at all than one like this.

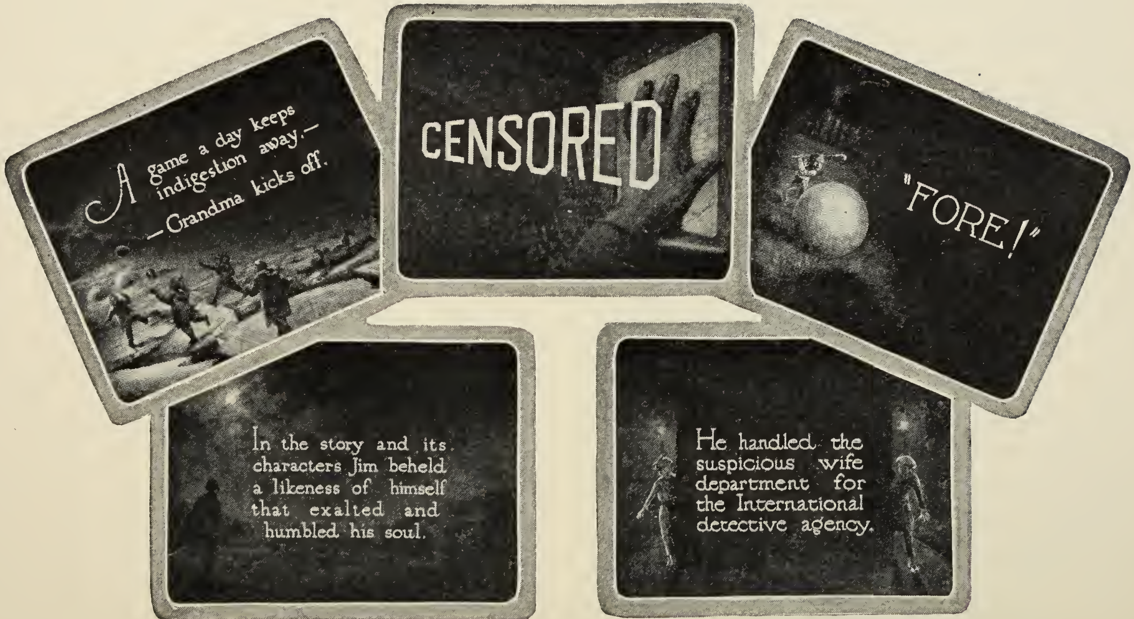
The motion picture title serves to give information in the simplest, most concise manner possible, and of such nature that it cannot be imparted by the action of the picture itself.

(*Title by Eno. Courtesy Amateur Movie Makers*)
A title made by lettering superimposed upon a diffused scenic background.

The basic title is nothing but a few words projected upon a black screen. From this simple beginning we have development along two lines. One line leads us to the ornamentation which makes the title attractive as a work of art while the other leads us to the beautification of the language used which makes the title conform to the best usage in language. We shall consider the latter point first.

In the first place never use a title unless it is absolutely necessary, but do not hesitate to use one when it is necessary. Observing this limitation in its strictest sense, you will find that your titles will run about 35% of your total footage, and this is really too much. Therefore the first step is to determine the titles which will not be needed. When this is done you may consider those which are needed.

In films made under control, a scenario is usually in existence and this contains, or should contain the titles. In other films, the titles are improvised during the preliminary projection. From these extemporaneous titles, the permanent titles are derived by altering the language.



(*Courtesy Amateur Movie Makers*)

A typical group of amateur titles.

Title Composition.—With a full list of titles, numbered in their proper consecutive order, the composition begins. In the first place, the English is to be improved to the fullest extent of the writer's ability. This usually means the lengthening of the title. But that may be disregarded at this stage. The title is written in a style to correspond with the spirit of the film. You would hardly make use of sonorous and dignified language in titling a comedy, nor would you, I trust, title a serious or even tragic film in the vernacular of the day. Thus the second step is the adaptation of the language used to the character of the film itself.

With these points established, the length of the title is examined. It will usually be found that the title can be cut down perhaps 50% without injuring it in the least, and often with the result that it is remarkably improved. When this third step is complete, we have the title ready for the more technical phases of inserting it into the film.

Title Footage.—Before making the exposure upon the title, we must know how much film to give each title. If we use too little film we shall have an unsatisfactory title, while if we use too much we shall have a monotonous dragging title which robs the film of valuable action. The common usage in the preparation of standard theatrical film is to allow one foot of film for each word up to ten, and one-half foot of film for each word thereafter. As professional film runs one foot per second we may restate this for substandard work as one second per word for all words up to ten, and one-half second for each word above ten. In this case, there is a fixed minimum of five seconds, even for a single word.

This is a standard established for making films presented to the general public, and unfortunately a large percentage of the public is illiterate to the extent that they have to read by spelling out the words upon the screen and do not read by word groups. The individual of average intelligence can read the ordinary motion picture title and grasp its significance, then start all over again and spell out the whole thing, letter by letter before it disappears. If you make film for general exhibition, use this standard.

However, for family films and for films to be used only for projection before educated and cultured people, one-half second per word will be ample with a three second minimum. If the title runs beyond twenty words, it may well be compressed to one-third second per word, although this is a little rapid for the reader who starts philosophizing in the midst of his title reading. A few trials will soon determine the footage you should allow for the most

(Courtesy Eno's Art Titles)

Titles may be either white upon black or black upon white. Due to the conditions encountered in projection the white upon black is preferable.

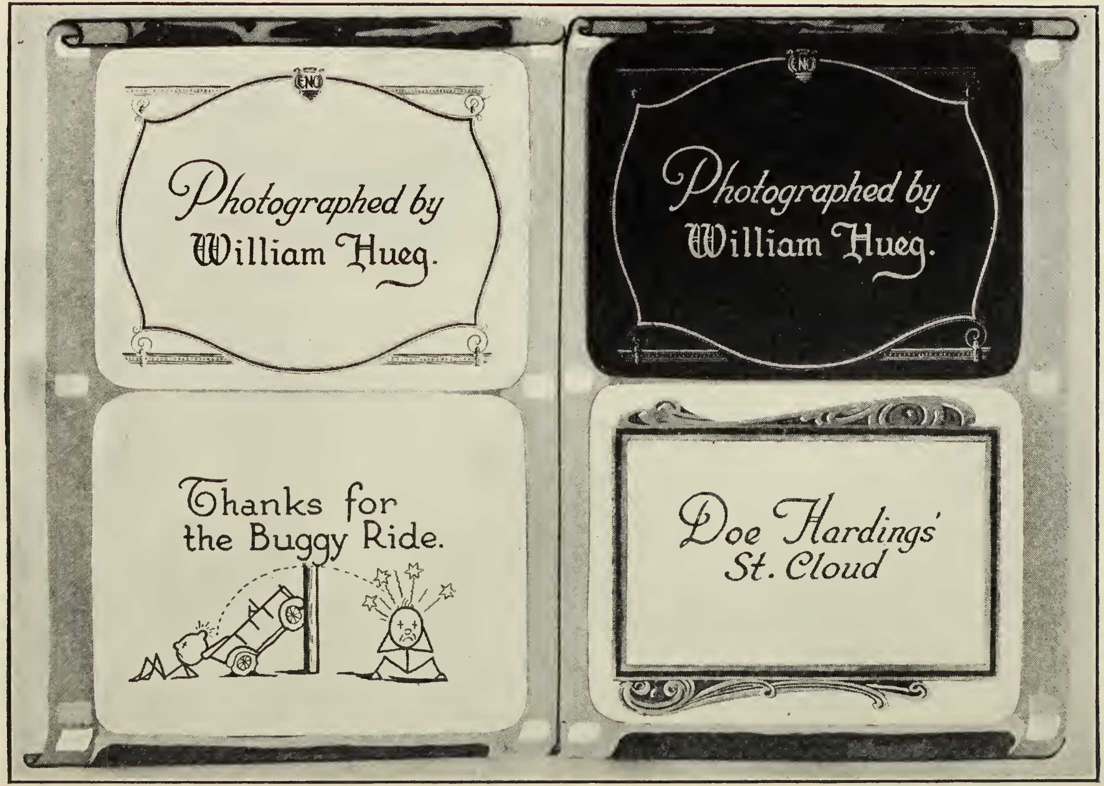
satisfactory projection under existing conditions. This should not, however, run to a greater footage than that determined by the professional scale.

Title Decoration.—So much for the bald word presentation. Before starting the actual exposure, the title should, as a rule, be "dressed up" to a certain extent. The main title group with the first title may be made as elaborate as one desires for few spectators stop to read them anyway aside from the simple title of the film. The sub-titles, or captions which are interspersed among the scenes throughout the film may be decorated to a certain extent, but as these titles are either essential to the film or so superfluous as to render their removal advisable, this decoration should be restrained to a point where it will not detract from the legibility of the title itself. A title whose ornamentation is entwined with the actual lettering makes the title physically illegible, while one with ornamentation so florid that the attention is distracted from the title may well be called psychologically illegible. Neither condition should be tolerated.

As the question of decoration naturally involves that of the style of letters used, and the type of background, we might as well consider all of these points at one time.

The background may be either a plain, conventional design, a subdued all-over design or a design appropriate to the scene which follows.

The background serves as a support for the title; by its contrast with the letters of the title it renders the titles clear and distinct. Its major purpose is to aid in the best possible presentation of the message of the title. For this reason the title which consists of plain white letters upon a plain black ground is regarded by many technicians as the ideal. It is true that this title is most legible and it is also true that it is often read unconsciously, the spectator reading it in the course of the film without consciously noting that the action has slipped to title and back to action against—but that requires superb edition! In the more common type of film, the films which you and I, dear reader, no doubt produce, this succession of dead black titles becomes monotonous. For this reason we turn



(*Courtesy Eno's Art Titles*)

1. A title card black upon white as reproduced by the usual finishing process.
3. Cartoon titles are quite suitable for many subjects.

2. If the card used in No. 1 is photographed directly upon positive film and cut in without printing or reversal it gives a very good white upon black title.
4. Simple border designs are quite effective.

to ways and means for relieving this monotony. The path of the professional who encountered the same difficulty may well be followed.

The words themselves may be of white, gummed paper letters glued to the title card or they may be white celluloid letters set in a specially prepared support. The last named is perhaps the least satisfactory as the fabric of the background with its numerous slots too often photographs just like a piece of fabric covering a slotted board. One of the first requirements of the title card is that it be uniformly black without scratch, break or mark of any kind upon it except the letters and design of the title.

The finest of all title cards are the hand lettered ones. This work is one which many amateurs will not care to attempt, but those who have had some training in lettering may very well try this work for themselves.

When the title is to be made directly upon positive stock for inclusion in the two film positive, and made for home development, the letters are written in black ink upon white card, on the contrary if the title is made upon reversible film or if many copies are wanted, the letters are in white upon black title card.

The best equipment for this work consists of a set of the special pens used by card writers. These pens make lines of specific width, and this width is not changed by pressure upon the pen point. Only the best waterproof draughtsman's ink should be used with a fine quality of white bristol or special black title bristol.

Lines are laid out upon the card, making the marks as faint as is possible and still have them visible. The faintest mark will photograph, but if these lines are very fine and very light they will not be noticeable. It may be remarked here that titles made upon half sheet (about 14 x 20) cards will photograph much better than the smaller size. This is due to the fact that an error of 1/20th inch in a line is not as noticeable in this size as in a smaller size. The larger the card the better will be the film title.

Using the lines laid out as guide lines, the letters are worked in with a free and easy sweeping stroke. Some little practice will be necessary before a satisfactory card

is secured, but it is quite within the ability of the usual amateur to hand letter his own cards. Mistakes, when not too serious may be corrected by the use of white or black ink, according to the color of the card itself.

For making titles, one will need a supply of cardboard or bristol board of the right size, one bottle each of white and of black drawing ink, a set of lettering pens, a lettering manual, and an assortment of practice paper. This work will prove to be very fascinating for those who care for designing, but for the amateur who has little or no ability in drawing, this attempt is not advised.

The decoration of the title logically starts with the border. This border may be a simple line, a double line, a curved and involved line or a line doubled upon itself in elaboration of the old Celic motif, but a design of some kind forming a border is a very good title decoration. There should be some kind of standardization of title borders. All of your films may be made with similar borders, but this leads to monotony. You may classify your films and use a different border design for each class, you may design a new border for each subject or you may have a half dozen assorted designs and use them alternately in all of your films. In this case it is a very good idea to embody some kind of identifying seal, monogram or design which is identical in all borders, which will definitely show that it is a scene from one of your films. This idea was carried to extremes in the old days of professionalism when, as many of you remember the Pathe films all had the "Pathe Rooster" somewhere in the set. However, used in moderation it adds individually to your films and gives them a certain distinction.

In case you use an elaborate border design, this may be made in the shape of a cut-out and the one design placed in turn over the various titles to be used. In this way hundreds of titles may be photographed by the use of a half dozen or so border designs.

This decoration is usually sufficient, but the title motif is often used. This consists of some object, drawing, or similar device which has some more or less definite relation to the scene, and which is photographed in the frame

with the title or the border itself may carry the motif. This is sometimes an actual scene or large decoration included by means of double exposure, but more often it is a symbolical design drawn upon the title card. This motif may be in one corner, it may occupy one side or the other or both ends of the frame, it may surround the title itself, it may cover the entire frame with the letters standing out by virtue of their increased contrast, but wherever this design is placed, it must not interfere with the full legibility of the title.

This style of decoration was carried to such an extreme in professional work that the public became tired of it. The amateur should use it with discretion, and unless the title writer happens to be an artist I should most earnestly recommend that the motif be dropped from titles. In their place, a process first popularized for amateur work by Syril Dusenbery of San Francisco may be used with all assurance that it will be fully satisfactory.

A still photograph is made of the scene which is to appear following the title. The negative of this scene is given a correct exposure and then given a short development. This negative is overprinted giving a photograph which has a fine but short gradation with its highest light below middle gray. This is used as a background, against which the pure white letters stand out very well indeed. Suitable backgrounds of this nature are published monthly in *The Amateur Movie Maker.*

The background covered with a uniform, conventional design, such as a tapestry design, is widely used by both professionals and amateurs. Many amateurs use wallpaper for this purpose and if a little care is used in the selection of the design it works very well indeed.

In selecting wall paper for title work, remember that colors have quite different values when photographed than when seen by the eye. It is a very good idea to make use of the monotone filter in making the selection. The filter will give the approximate photographic tonal value of any design, and is far more reliable than the unaided eye.

Finally we may have the title prepared for us by a

professional title maker. This is obviously the source from which the most satisfactory titles may be made, and with the exception of those who wish to have the pleasure of originating their own titles, the process which is to be advised.

These firms make a specialty of designing and executing titles which will be the most appropriate for your own films. They have practically every device available which is used by the professional title writer. Titles are prepared with uniform motif-borders, or the more common double exposure type of title may be secured if desired. In fact there is little limit to the titles which may be obtained from such a studio. The cards themselves are hand drawn in the case of the better grade. It cannot be too strongly emphasized that the hand drawn letter has a quality which has not yet been successfully imitated by any mechanical process. The nearest approach to hand lettering is the printed card made by using the "title" or "pastel" type face. These cards are considerably less expensive than the hand drawn card yet they are much better than the usual cards made with the commonly used printer's types.

From the foregoing we shall select a type of letter and a background to suit the film we have in hand. The letters are applied to the background giving us the original of the title. This must now be photographed.

(Courtesy Eastman Kodak Co.)
A "Kodak" title.

TITLE PHOTOGRAPHY.—There are two cardinal points to be observed in photographing titles. The title card *must be* parallel to the film surface with the optical axis of the taking lens perpendicular to the center of the card, and the card must receive uniform illumination. If the cam-

era is tipped up or down or if it faces the card at an angle, no matter how slight, one side of the title will be larger than the opposite side when projected. If the optical axis is not directly opposite the center of the card the title will not appear properly centered during projection and if the lighting is not uniform, the title, when projected, will have one side brighter than the other.

When the card is placed in proper position relative to the camera, the lights are arranged. High-powered lights are not necessary, although the arcs, if available, make excellent title illuminants. With them, a small diaphragm and slow crank may be used to secure the very best definition. Proper exposure is determined by the use of the Cinophot or by making short test strips and developing them. In this way the exposure is determined. When this is done, the camera is operated until the predetermined length of film has been exposed, using the basis of two and one-half seconds to the foot of film for purposes of calculation.

When this is done the title is ready for development and then cutting into the film. This covers most of the ground for title work in so far as the ordinary title is concerned. There are, however, a number of titles which are made in ways quite different from this.

Making Titles Coincidentally with Scene Shots.—It is often desirable that titles be made at the time the film is exposed. This is most desirable in travel films, under conditions which make title production the most difficult. This has been overcome in various ways by different manufacturers. The Pathex camera has as an accessory, the Pathexgraph. This is a folding frame and auxiliary lens which may be carried in a vest pocket. It is supplied with a number of small cards upon which the title may be written. In this work it is best to use a rapid drying, very black ink to produce the greatest possible amount of contrast. The title is hand written as it lies in the closed easel. The easel back has an opening of the proper size and shape to "frame" the title. The card, when written, is removed from the rack, reversed in the easel and the easel opened. When this is done the sup-

porting collar is secured to the lens barrel, the title lens dropped into place before the lens and the title photographed in the usual manner. Naturally, in this case not more than four or five frames are exposed as the projector stops automatically for the titles.

(Courtesy Bell & Howell)

The Filmo character title writer is a very compact but invaluable accessory. With it not only titles, but closeups of various small objects may be made, cartoons may be animated and similar work done.

The Bell & Howell Character Title Writer is not designed to be actually carried in the field, but it can be easily transported with the rest of the outfit and the day's titles made each evening. This title writer is so arranged that the hand may be shown upon the screen actually writing the title. The cord is plugged into any convenient electric socket, the camera attached to the base, a card inserted in the holder and the base raised to a comfortable working position.

The lights are turned on, the exposure determined by the use of the exposure meter, and the hand placed in position. The left hand now controls the camera while the right hand forms the titles. The camera should be run at half speed on this work and the exposure calculated in accordance with this. The reason for using half speed is that otherwise the actual writing would take too long upon the screen. Half speed makes the hand skim across the screen very rapidly. If the hand is not to be shown in actual motion or not at all, the title is written or printed and placed in the easel. The exposure is now made in the usual title manner. Thus this title board serves a dual purpose. In addition to this it may be used for

MAKING TITLES WITH THE GOERZ TITLE DEVICE

1. Writing the "card" upon matte celluloid.
2. The "card" and its holder.
3. Inserting the "card" in the holder.
4. Inserting the holder in the mask slot.

When this is done the title is focussed with the focussing magnifier and the exposure made by directing the mask box toward a white reflector and operating the camera in the usual manner.

photographing very small objects in a larger size than would otherwise be possible.

It must be remembered that in making titles with such devices that the focal length is lengthened considerably. It is a good practice to make the exposure calculation and to then add one-half point to the f value used. Thus if the meter indicates that f 4.5 should be used, increase to f 5.

GOERZ TITLES.—The Goerz mask box lends itself unusually well to the making of titles. These titles are drawn upon tracing paper or matte celluloid. The letters may be drawn in white upon black or black upon white. The white letter upon the black ground makes a very fine title indeed. We shall take this as an example.

The title is drawn in detail upon a sheet of drawing paper. This enables any desired changes to be made as the title is being drawn. Borders, designs and so forth may be added at pleasure. When the drawing is complete, it is ready to be traced. A piece of tracing cloth is placed over the drawing and the outlines traced in ink. The background is now filled in between these lines, with a brush. Be sure to use a sufficient quantity of drawing ink to render the background absolutely opaque.

The title drawn upon matte celluloid or tracing cloth is now inserted in the special metal "frame" supplied with the mask box. This is then inserted in the mask slot of the Goerz mask box. It may be mentioned that fancy "effect" masks may be used in the same manner.

The camera is now placed upon the sliding base. The lens is focussed upon the title by means of the focussing microscope, and the whole is pointed toward the sky, a pure white reflector or a light. As the inside of the mask box is shielded from the light and as the india ink is opaque we have a black which is *black,* and a white which represents the brightness of the sky. In short, we have a contrast scale which is far beyond the power of the film to record as actual tonal value. The consequence is that we have a pure white letter upon an absolutely opaque ground. This gives us the very finest title quality possible to obtain.

It will be seen that there are few accessories more versatile than the Goerz effects.

A similar effect is secured by drawing the titles upon glass or celluloid sheets and photographing by transmitted light.

In title work there is an opportunity for the use of a limited quantity of applied design. Thus if the film is made in the Orient the letters may be formed of cuneiform wedges, Arabic scrolls or Chinese dashes. If the film shows the manufacture of pearl buttons, small buttons in rows may be made to spell out the title. If the film depicts the events of a seaside vacation the titles may be actually written in sand and photographed when a low sun casts long shadows. There are endless possibilities in the field of novelty titles, and every film will have a certain atmosphere which will indicate the possibility for the use of special titles.

Trick Titles.—In the line of novelty titles, there is one division which offers unlimited opportunities. This is the trick title, the trickery usually consisting of some form of animation. In consideration of this work, it is better to follow the system used in the discussion of trick work.

Revolving Circles.—A title is often shown in which kaleidoscopic figures revolve about a central disc. This effect is easily obtained by the use of two discs. One is of cardboard and colored in uniform segments of a geometrical pattern. The second disc is of celluloid and colored with transparent non-actinic colors arranged in a complementary pattern. If the two discs are revolved in opposite directions the kaleidoscopic effect is at once apparent. To block the center the central circle is painted dull black, while the cut out mask has a larger and concentric circle cut in it. The two discs are placed behind this mask. This leaves only a narrow circle showing the weaving color design. This same effect may be elaborated to any desired extent.

Revolving and Exploding Star.

A large star is pivoted in the center of the background. This is turned by means of animation. The single exposure is used. The star, a five-pointed one, is turned one-fif-

teenth of its circumference between each two exposures. That is, three frames are required to move one point to the position originally occupied by the preceding point. Continue this animation for about one foot or 40 frames. Then pivot a small star just at the points of the large star and, after using it for a guide, the large star is removed and the small stars are rotated in the same manner. After about 20 frames of this, one star is removed and a few tiny paper stars scattered about, then eight frames and this is repeated, and so on each eight frames until the board is covered with small stars. Now with each exposure move all stars upward slightly and continue this motion until the stars have been grouped to form the desired title.

Upon the screen the large star will revolve rapidly, then it will explode and in its place five smaller stars spin. These in turn explode and the screen becomes covered with small stars which dance about until they become grouped into letters and words.

THE SNOW TITLE.

EFFECT.—A miniature set is shown with a snowstorm beginning. As the snow falls it piles up on an old fence and forms the title.

METHOD.—This is a rather difficult title, but its beauty will amply repay the experimenter. A box is built which has a screen wire bottom shaped to resemble the uneven contours of a field. A toy house with two or three fantastic toy trees are firmly tied down to this foundation. The walls of the box have a scene painted upon them, while the front of the box is a sheet of good plate glass. The box should be about eighteen inches square and perhaps a foot deep. The top has a curved shield leading into a similar box behind the scene box. A strong electric fan placed below the scene completes the mechanical arrangement.

Small wooden splints are arranged to build a weathered fence, the color being such that the sticks blend into the background.

Small tufts of cotton are now placed carefully on these splints in a position to form letters, and then white paper

confetti spread over the miniature scene until a heavy snowfall is simulated. The camera is now placed before this set *upside down,* the lights turned on and the camera started. When the camera has been started, the fan is switched on. The confetti will rise in a cloud, while the surplus will be blown to the top, deflected by the hood at the top of the box and fall into the rear box. Continue for a sufficient length of time to register the storm. By the end of five or six seconds most of the confetti should have been blown out of the box, and if the cotton has been carefully placed upon the splints it also will have been blown out of the box. When this film is developed and turned end for end, the effect will be as has been described.

THE SANDSTORM.

An Arab encampment is seen in the desert, a sandstorm comes up and whirling sand fills the air, this swirls about and finally dies down. The camp has disappeared, the sand has been ranged in dunes which form the letters of the words. This is a most mysterious effect and one which always excites admiration.

METHOD.—For this purpose two backgrounds are needed, one is the black title card which will bear the title and the other is a formed sand base. Using compo board as a base, tack and glue window screening to it formed in the shape of dunes. Give this a coat of glue and sift sand over it until the glue will take no more. Let this harden. Then secure some of the small metal camels, Arabs, tents, palm trees and similar objects which can be secured at novelty shops and glue them in place to form an encampment.

The camera is suspended above the black card. Upon this sand is carefully released from a paper cone to form letters. If any sand is spilled in a wrong place, a soft brush is used to bring it back into place. The camera is suspended with the top of the camera toward the bottom of the title, *i. e.,* relatively up-side down. The camera is started and allowed to run for a length of time sufficient for the title to be read, then an electric fan is started and directed at the sand. The sand, which should be fine, white sea sand, is blown off the card, but before it is all

gone the camera is stopped and the card removed. The second or miniature card is substituted for the title card, and clean, fine, dry sand sifted over it until it is a half inch deep or more about the miniature objects grouped on the background. The camera is started and immediately afterward the fan is started, and the camera allowed to run until the miniature is fully revealed. When this title is developed a few frames may have to be cut from the portion of the film where the substitution took place, but when this is done there should be a smooth transition from the white sand letters on the black card to the revealed desert scene. This all having been done in reverse, the effect will be as described.

In filming the latter half of this scene, it will be necessary, in order to secure proper perspective, to photograph the miniature at an oblique rather than a vertical angle.

> ALTERNATIVE: In case the miniature set is not used, the effect will be a swirling sandstorm upon the screen which blows down into letters. This is far easier to make, but hardly as effective as the first method.

The Dancing Sand.

This is really a variation of the "Sandstorm," but the effect is so widely different that it may be described as a different title.

EFFECT: The screen shows a beautiful geometric design which shifts into another and this into still others, each change bringing the sand to a closer resemblance of letters. Finally the title is formed in clean-cut letters of sand.

METHOD: For this some special equipment is needed. A plate of thin but stiff brass sheeting about two feet square, which should be darkened with some chemical stain. A firm stand or other support which will not easily vibrate, a steel rod one-half inch in diameter and some six inches long and a violin or 'cello bow.

A hole is drilled in the exact center of the brass square. A hole is drilled in the end of the steel rod and this is tapped out. A plug is screwed into this hole with about one-eighth inch projecting from the rod end. The hole in the brass sheet is countersunk, and placed over the plug

and the plug riveted down. The plate is then soldered to the shaft. This work can be done at any tinsmiths or machine shop for a purely nominal sum.

This plate is placed in the wooden support, and this secured firmly to the table. The plate is now supported upon the end of the steel rod. The sand is sifted over the plate in the form of letters just as was done in the sandstorm. The title is given an exposure of proper duration and then the bow is drawn over the edge of the plate. This is continued with stroke after stroke. With each stroke the sand dances and shifts and soon it takes definite geometrical forms. As the bow is drawn over different parts of the edge of the plate this form will change but remain symmetrical. This gives us a very beautiful title.

> CAUTION: This title as was the case with the others preceding is made in reverse. The camera is so adjusted that the bow never comes into the camera field.

THE METAL LEGION.

This is another variation of the sandstorm, but entirely different from that effect.

EFFECT: The screen is seen covered with black granules. These granules shift and pull together and soon the granular form is changed to a crystalline form, the structure being needle-like. These needles rise on end and march in martial ranks to a common heap, where they merge with the rest of the mass. Soon these masses take the form of letters and soon the letters are clearcut and distinct.

METHOD: This title is formed with iron filings. They are sifted upon a white card ground, just as the sand was sifted on the black card. When a sufficient footage has been exposed, a powerful horseshoe magnet is drawn back and forth beneath the card. The letters are disintegrated and as the magnet is swept back and forth, from side to side and in a circular path, the card becomes covered with the long needle-like crystalline form of magnets. Then a few finger taps on the edge of the card will reduce these to the original powdered filings. This title, also, is made in reverse.

THE JUMPING ACROBATS.

This is a title which always finds favor with the spectators and one which, if well made, may be used with almost any light subject.

EFFECT: A number of white paper silhouette figures dance about on the ground in the foreground of the title space. There is a jagged tree limb reaching across the top of the screen. The figures jump upward and cling to this limb, then others jump and cling to them, and so on, until the whole swarm have formed letters by hanging monkey-wise to this limb.

When the paper has been folded it is cut as shown in the small diagram above. When the paper is unfolded a string of dolls will be disclosed as shown in the lower diagram. These are cut apart at the elbows to form the individual dolls for use in making the animated title described.

METHOD: The first step is to cut out a number of paper figures. This is done by folding a paper back and forth upon itself several times and then cutting as shown in the diagram. These figures are scattered all along the lower edge of the title board with their feet about on the same level. Expose eight frames of this, then start single-frame animation. Raise one figure for each letter entirely above

the crowd and expose, raise these to a second level and raise another set to the first level. The third level is now reached in a similar manner and the fourth level attaches the hands of the figures to the limb. At this stage you have for each letter of the title one figure attached to the tree limb and three in the air. In addition to this animation the figures on the ground are raised and lowered and changed with each exposure giving the effect of dancing about. The next step is to attach the figures of the third level to those upon the tree branch. As this title is made lying flat with the camera suspended above it, one figure is attached to the next by laying it so that the hands of the lower figure are over the feet of the upper.

This is done until all vertical members of the letters are formed. Then the remaining figures jump upward to take their places along the cross bars of such letters as "H," "A," and so forth.

> This title is straight animation and is not made in reverse. Remember that it takes sixteen exposures to make one second of projection. Time your movements in accord with this. If the figure makes the jump in four movements that means that upon the screen it will leap up in one quarter second. This is about right for this kind of motion. Careful animation will produce many varied and beautiful effects, and is one of the most fascinating phases of motion photography.

THE MARKSMAN.

This is one of the best types of title to use for illustrating hunting and camping scenes, and as it partakes of cartooning it will be well received by the audience, especially if there are numerous sportsman friends included.

EFFECT: A hunter is seen standing before a large, blank billboard. He raises his rifle and takes aim. He fires. A burst of smoke from the gun is followed by a spot and splash upon the board like a bursting egg and the letter appears. This is repeated until the title is complete. Complete words may be substituted for letters to make the title run through more quickly.

METHOD: For this work a cartoon frame is necessary. Make a shallow box about six inches deep and 20 inches

square. In the top of this box set a piece of plate glass one foot square, and inside the box place one or two electric bulbs. In this case we shall use one stand for both drawing and taking.

Next secure a package of unruled white paper such as is used in school notebooks. Lay one of these sheets upon the glass so that the perforations come just above the edge of the glass. Drill two holes and set wooden or metal pins in the top of the box. These pins serve to keep the various sheets of paper in register. Finally you will need a dozen or so sheets of thin, transparent celluloid cut to the same size and perforated like the paper used.

Find a drawing of a hunter with his gun. Lay this upon the glass, turn on the light and trace this figure upon a piece of the drawing paper. Now draw the billboard in the background, of such size that it fills about two-thirds of the frame. In drawing the hunter have his gun by his side. Then make three more identical drawings, but sketch the gun in different positions and finally have the gun at his shoulder pointing at the signboard.

Now place a piece of celluloid over the drawing of the hunter with his levelled gun and at the muzzle draw a half dozen pen strokes spreading out fan shape from the muzzle. Using a second sheet repeat, but make the lines longer with some "smoke" billows and make the third one with the smoke covering half the frame. These sheets we call (a), (b) and (c). Now upon a fourth celluloid sheet draw a round spot, then this spot broken as in the usual Fourth of July comic strip while the third sheet of this series shows the spot bursting over the whole signboard. Finally supply yourself with the necessary small gummed letters to form the sign.

We are now ready for the actual exposure. The camera is set up above the cartoon box and the first drawing of the hunter and the billboard is placed upon the board with the pegs through the perforations of the paper. This is given eight frames exposure, using the single exposure device of the camera as is used in all animation. To follow the work figures will be given in parentheses to indicate the total number of frames exposed. This initial

exposure gives us eight frames (8). We now substitute the second drawing showing the gun slightly off the ground. (No lights are lighted inside the box, the usual title side lights are used.) This is given two frames (10), then the third gun drawing is substituted and two more frames exposed (12) and finally the gun in position at the shoulder is shown and given two exposures (14). This gives us almost one second for this entire motion.

The drawing of the hunter with gun leveled is now left in place for the entire title. Celluloid sheet or "cell" (a) is now placed *over* the drawing and given two frames (16), then this is removed and cell (b) put in place with two frames exposure (18) and then cell (c) is given for two frames (20). The next step is to substitute the spot cell (d) with two frames (22), then in turn the three explosive cells (e), (f), and (g) and given two frames each, making a total of (28) frames or something over one and one-half seconds for the entire action. Now remove the last cell and glue the first letter or word in place and give four exposures (32), now each 18 frames will add a new letter or word. If words are used this will approximate reading speed so that if a complete word is given for each "shot" the completed title need only be run for five seconds after completion. If the title has been a five-word one use one second for preliminaries, 90 frames or almost six seconds for the five words and three seconds of the complete title, a total of ten seconds for a five-word animated title, which is quite ample.

THE VOLCANO.

This may be made quite impressive if proper care is taken. The print should be made upon red base film or tinted red after development.

EFFECT: Smoke rolls up across the screen in dense clouds. Letters become faintly seen through the smoke. The smoke fades as the letters become more and more distinct and finally the letters are formed of curling, rolling clouds of smoke illuminated with weird light while the background is black.

METHOD: This effect also requires some rather extensive preparation, but it is surely worth the trouble. A box

is made about eight inches deep and whose width is equal to the length of the title cards. The height of the box is one foot greater than the width of the title card. The title is cut from the card, leaving openings to correspond to the letters. Do not cut stencil fashion, but cut the letters out entirely. Then glue a sheet of celluloid to the back of this card and upon this glue the interior parts of such letters as "O," "A," "R," and so forth. Set this card in the front of the box which has been prepared by cutting out an opening to correspond with the lettered portion of the card.

Electric lights are placed inside the box at the bottom with reflectors arranged to throw the light upward. The top of the box is left open, and behind the cut-out title board are hung in rotation from front to back: a plain black sheet of title card, a heavy gray paper sheet, three sheets of white writing paper, a piece of chiffon weighted to hang without wrinkling. These are placed as close together as possible.

At a chemists' supply house secure four ounces of hydrochloric acid (CAUTION—this is a powerfully corrosive acid and will burn painfully if even a small drop is allowed to fall upon the skin), and a similar quantity of stronger ammonia, two 50 cc., beakers, two long, plain pipettes with rubber bulbs. These pipettes are somewhat like elongated medicine droppers.

Bore a one-inch hole in the rear of the box which is about one-half inch higher than the tops of the beakers which are placed inside the box, side by side.

Set the camera up in front of this box and focus it carefully by the use of the reflex focusser. In front of the box, at the bottom, set two butter dishes side by side. When ready to start the photography, which should be made at half speed, light the lights inside the box as well as the usual side lights, then, using the pipettes, place a few drops of acid in one butter plate and a like quantity of ammonia in the other. Fumes will rise which will photograph nicely, and which are harmless. Photograph this for a second or so, allowing the camera to continue its action automatically.

Working as rapidy as possible, place a pipette full of acid in one beaker and ammonia in the other. The pipettes are inserted through the hole in the rear of the box. If there are two workers, so much the better. One will keep the beakers supplied with chemicals, causing the "smoke" while the other manipulates the drops.

The black cardboard is removed from the box with a quick upward motion. The letters will then be shown faintly. The gray paper is now removed, the butter plates are removed from the front and the side lights extinguished, ending the smoke from the front of the box. The other drops are removed in quick succession, leaving the chemical smoke rolling behind the celluloid. Place a cardboard over the top of the box, and fan the top with the hand, making the smoke swirl. Continue for as long a time as is necessary to complete the title footage. Develop and print upon red stock.

> CAUTION: Make tests to see if the illumination is sufficient. If not, a small folding arc such as the Traut-Minima may be placed inside the box, or an arc such as the Cameralite or Little Sunny should be placed at the rear of the box.

ANIMATED TITLES FOR SCENIC FILMS.

This is a means of adding considerable interest to scenic views and avoiding the monotony of the usual black and white title. It is, however, applicable only to those films made, developed and printed at home.

EFFECT: A soft shot of a waterfall is shown. As we watch there is a shimmering glitter in the water, a ball jumps out followed by a stream of others forming a glittering line across the scene which then changes to the title of the scene.

METHOD: This is simple animation combined with double printing. The first requirement is a negative film of the scene with the correct footage. Of course, the necessary footage of a longer scene may be used, but the minimum usable footage is that of the title as it will appear upon the screen. The second requirement is an enlargement of one frame of a size equal to the title card used, and as this work is of such peculiar nature a fairly small

enlargement is to be used, say 4 x 5 or 5 x 7. For the actual photography the character title writer may be used to very good advantage while the enlargement may be made with that valuable little instrument, the Dremmette motion picture enlarger.

Using the enlargement as a guide, and celluloids as bases, faint outlines are drawn indicating the place for the shimmering effect to take place in the water. Then another is shown where this effect spreads, a third shows an increasing area and this is continued until the shimmer has been extended to a line entirely across the frame. This should make use of at least twenty "cells." Now we come to the actual photography.

An unmarred black card is placed upon the easel, which must be horizontal. Upon this the cells are placed for the actual exposure. This is rather particular work and requires a nice adjustment of lights for the best results. An arc light should be used and this light should fall from one side only. The actual material to be photographed is the decorative material sold in art shops as "metallic." It is a finely ground foil and should be in silver color mixed with a very small amount of varicolored metallics such as is sold under the name of "Cashmere."

The outlines as shown in the cell drawing are filled with these metallics in very limited quantity. In fact, the individual flakes should be apparent. One frame is exposed, the cell is lightly tapped to slightly change the position of the individual flakes without changing their relative positions, a second exposure is made and so on for four exposures. Now the second cell is placed upon the easel and four more frames exposed, then cell number three and so on until a total of eighty frames have been exposed upon twenty cells. This gives five seconds' screen time. Now the twenty-first cell is prepared by placing it upon number twenty and pasting the white letters of the title proper to it. This is then given the proper title footage and the photography is done. However, this is but half the task.

This film is carefully developed for a longer time than usual in a slow-working developer. This will tend to give the greatest possible contrast in this film. If the film has

been properly developed and properly exposed, the portions which are not component parts of the design will be absolutely clear celluloid.

This is dried and polished as explained in the experimenter's chapter. When this is done the film is ready for the final step in its preparation.

The printer will have to have an auxiliary film roll support arranged, for we are going to run three films through it simultaneously. The negative of the scene itself is threaded into the printer in the usual manner with the dull side out. On top of this is placed the title film with its celluloid or polished side next to the dull side of the scenic negative, and finally the positive raw stock is placed in the printer with its dull surface facing the dull surface of the title negative. This combination is now run through the printer. It is evident that the negative will be printed upon the positive except in those places where the positive stock emulsion is protected by the black design of the title negative. It is furthermore evident that as the negative (scenic) is separated from the positive stock by a distance equal to the thickness of the film that this scene will be printed in a soft manner. Thus when this final print is developed we will have a soft, diffused scene, upon this the sharp, glittering metallics will appear to the greatest advantage, giving a title of great brilliance.

It is seen that there are endless possibilities in the making of titles. A few experiments will make the amateur familiar with the modus operandi of animation, cartoon work and similar manipulation, which are, after all, very simple, their only difficulty being that they require tedious manipulation.

Film Plates.—Many amateurs make a practice of using stock titles, the idea being taken from the professional producer. This is a very good idea and as a precedent we may point to the use of book plates by these members of society who fully appreciate the value of books. As there is no question but that the home film will prove to be a serious rival of the publishing business, films may and should be regarded as a form of book. Let us then start our film libraries correctly by designing a proper "Film-

plate." If a copyright is desired this may be secured by sending two copies of the design with two dollars to the Patent Office at Washington. It should be specified that this drawing is not for purposes of publication.

As this title will be used repeatedly for every film in your library, it deserves the expenditure of some time and thought. In the first place, a cutout must be left if it is to serve as a main title, but this is hardly the best way in which the title can be used. The main title should partake of the character of the film to be shown. Moreover, as these films are more usually record films than anything else, the title should convey certain definite information. For example, let us consider a film made in New Orleans. Our main title could very appropriately be decorated with a heraldic ribbon design, with the arms of the French Empire as the central ornament and with Fleur de Lys as motifs. The text would be—

NEW ORLEANS
The Capital of the Southland
December 15th to 30th 1927

This title would be followed by the "Film-plate" title—

From the library of
JAMES HENRY WORTHINGTON

Some amateurs make use of the familiar phrase "Ex Libris" but this usage is not yet fully established. The choice of phrases will be left to the individual.

The design of this title is usually heraldic, and certainly, if the amateur is fortunate enough to have undisputed right to the use of arms, they may be incorporated most appropriately, but for the sake of decent taste, it is to be hoped that those who have not such right will not follow this suggestion. It is true that there is no law in this country prohibiting the use of arms by any individual, but such unauthorized use is, to say the least, in execrable taste.

When such arms are used, the shield alone may be incorporated in the borders of the captions, but in such case all

of the appurtenances should be omitted. In any case a simple monogram may be substituted.

The final scene of the film should fade out. In case a fade has not been incorporated in the film itself, a "white fade" may be made in the printer. In this case, the "Finis" title is made with black lettering upon a white card and photographed with a fade-in as has been explained. In printing this fade-in is placed over the termination of the last scene. This will cause the scene to gradually lighten until the final title is shown in black upon the white screen. As this tends to a harsh lighting effect, this final title is given a long fade-out, so that the screen is finally black.

The final title appropriately incorporates a scrolled "Finis" and this changed or faded into the maker's monogram.

We have given considerable space to the subject of titles, but their importance cannot be overestimated. Good titles and good edition will make a presentable film of any subject provided the photography is at least passable. When the full significance of this statement is grasped, the importance of titling will be appreciated. We are all familiar with the dull, sodden, impossible films made by so many amateurs who attempt to interpret their production by a running fire of comment. This is very irritating. In fact, no film is ever presented to its best advantage without music and a hodge podge of music and comment is maddening.

If the amateur wants to secure the best possible results from his motion photography he will carefully edit the film and will then further improve it by the careful preparation of every title from the main title to

"FINIS."

CHAPTER EIGHT

TRICK WORK WITH THE MINIATURE CAMERA

Trick work has a very important place in motion picture photography, and one which is not correctly understood by the average amateur. Trick work is used, not to secure effects of unnatural aspect alone, but more often it is used to present a natural effect which could not be secured by straight photography, and it is used for many instructional and educational purposes. Trick work, in short, includes every phase of motion picture photography except straightforward, normal speed photography.

There is an "alphabet" of trick work, a certain limited number of basic manipulations, from which all conceivable *camera* effects are secured. We must remember that motion picture trick work is used, not so much for clowning and slap-stick as for securing impressive effects, and to this end all means are adapted. We thus find camera manipulation, printer manipulation and various mechanical effects which have nothing to do with either camera or printer directly. Thus reversed film travel is a camera effect, travelling matte effects are produced in the printing while glass paintings are used before the camera and are not strictly within the bounds of photographic manipulation at all.

In this chapter we shall dwell more upon the possible camera manipulations with some consideration of the printer manipulation possible with the amateur printers now available, but mechanical effects will be ignored completely.

CAMERA MANIPULATION.—In camera manipulation we may change (1) the direction of film travel, (2) the area of the film exposed to the light, (3) the speed of the travel, and (4) the amount of light which falls upon the film. From these four elements we construct certain secondary

units and from them, in turn, the whole structure of camera manipulation is built. We shall now consider these in detail in their relation to amateur use, and with full cognizance of the limitations of the amateur camera as available to the amateur of to-day.

Thus, in the order given in the foregoing paragraph we have:

(a) Forward travel (1)
(b) Reverse travel (1)
(c) Entire area exposed (2)
(d) Restricted portion exposed (2)
(e) More than normal rate of travel (3)
(f) Normal rate of travel (3)
(g) Less than normal rate of travel (3)
(h) Alteration of the amount of light admitted by the lens (4)

It may be stated that any camera manipulation may be performed with the amateur camera provided it does not require that the film be *carried through the camera* in reversed direction. Some effects are somewhat difficult, and others are easy, but this is practically the only one which is absolutely impossible with the small camera. However, even those effects which are usually considered as being dependent upon a reverse film travel, may be, with a little trouble, so closely duplicated with the amateur camera that all practical needs of the amateur production are met.

Those effects which require this are the double and multiple exposures, lap dissolves, ghosts, visions and similar effects, every one of which can be performed with the miniature camera. It is true that the procedure will not exactly duplicate professional procedure and may entail some rather tedious work, but the final effect will be quite satisfactory as we shall see later in this chapter.

Starting with the simplest camera manipulations, we will consider first of all:

STOP CAMERA.

This is just what the name implies, that is, the camera is stopped abruptly, some change made in the set and camera operation resumed.

EFFECT.—A young married couple are having their first breakfast alone, he reaches for the bread plate, but is watching his bride and sticks his fingers into his coffee cup, he jumps and then reaches again for the bread plate, just as his fingers reach the plate, it changes to the coffee and as often as he reaches for the bread plate it changes to the coffee just as his fingers reach it. Alternative, a man reaches for a cigarette humidor and picks up an ash tray, and as often as he changes, the substitution takes place. Other alternatives include a stein of beer eluding the grasp of a drunken man, the substitution of a man for a girl just as another man starts to embrace her and other effects, practically all of which are used for comic effects. This is also used for ghosts, demons and similar supernatural effects.

METHOD.—To take the first example we make straight film until we arrive at the place where the groom reaches for the bread after burning his fingers in the coffee. Just as his hand reaches the bread we stop the camera, change places with bread and coffee and proceed. This is the procedure followed in each instance.

> CAUTION: In this work all actors must remain absolutely motionless during the period the camera is not in operation. Otherwise the sudden jump due to changed position would spoil the miraculous effect of the trick. This motionless attitude of actors is common in many effects and is referred to as "freezing."

REVERSE MOTION.

There are few single effects which can provide as much interest and amusement as the reverse camera, and when combined with slow motion, such films often form the most highly valued single items in the film library. As this is a versatile trick we must consider several effects in one group.

EFFECT.—(a) *Normal motion is shown in reverse.* Thus we have a swimming scene, where fancy diving is the feature. We see a swimmer suddenly rise from the water a short distance, poise and sink from sight. Then we see a turmoil upon the surface of the water, the diver rises feet first, ascends through the air in a graceful curve and lands

lightly upon the diving board. Such an effect always provides the utmost interest and evidently spectators never tire of watching it, even after they are let into the secret.

(b) *Miraculous effects.* The Fisherman and the Genie. Here we see the fisherman by the water's edge. He is a modern disciple of Walton, dressed in modern sport togs and equipped with the latest in rod, reel, and so forth. He lights a twig fire and a cloud of smoke rises. As he starts back in surprise the cloud spreads to huge dimensions and then pulls together and runs back into the fire which goes out even though the fisherman tries again to light it. He scratches his head and starts toward the water's edge. There he sees a splash and throws up his hand. A fish lands in it. Then all he does is to stand by the shore and catch the fish as they jump out at him, depositing each one in his creel as he catches it. When the creel is full he picks up his rod, looks at his fish and starts home.

(c) *Thrillers.* (This is rendered far more effective when combined with slow camera). A man is seen jumping from side to side in a road while bearing down upon him is an automobile coming at breakneck speed, also zig-zagging trying to avoid him. As the machine is on the point of running him down, he leaps upon the fender and is carried far over the bonnet of the machine by the force of the impact. He is carried on out of the picture.

METHOD.—(a) As all reversed effects are secured, when using the amateur cameras, by holding the camera upside down it is evident that a spring driven camera is essential. The first effect is made by simply holding the camera up side down and filming the scene as usual, slow motion being used if preferred.

(b) This effect requires somewhat more care. The film is shot "straight" up to the fullest expanse of the smoke cloud. This is formed by a motion picture "smoke-pot" which can be secured from any fire-works manufacturer for a few cents. When this is done the camera is stopped. The fire is now relaid and time allowed for the smoke to blow away and the same thing is repeated in reverse, but this time the fisherman does very little moving. Do not

allow any flame to show on the match or you will see him pull a lighted match out of the fire, strike it and thus return to its unused condition. When this is done you return to straight motion, the fisherman arises and goes to the edge of the lake where he looks out over the water. Now reverse again and have him reach into the creel, pull out a fish and toss it into the water. This is repeated as often as desired. The final shot is made "straight." When this film is returned to you developed, you will find that when projected it shows nothing but some scenes upside-down upon the screen. You then cut the film apart, taking each reversed scene by itself. These scenes are joined back into the film in just the position they originally occupied, but turned end for end to bring the tops of the frames in the correct position. This naturally brings the end of the action where the beginning should have been and you have your reversed motion.

(c) This effect is quite simple provided you operate the camera at a very slow rate of speed. The actor takes his place upon the fender, bending far over the bonnet, the machine backs into the camera field and at a predetermined point the actor rises to a standing position, throws his arms up wildly and jumps from the fender to the road, always facing the machine. He lands as awkwardly as possible without falling, then dances back and forth across the road while the automobile starts zig-zagging the instant the actor jumps, continuing its way backward out of the picture. As the slow camera will speed up all motion, and as the reverse will show us this action in just its reverse order we see how simple it is to film the most thrilling stunt pictures without endangering any of our actors in the slightest degree.

Stop Motion.

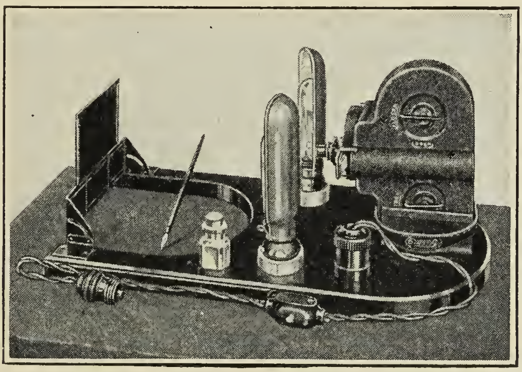
Stop motion is a term very loosely applied. Strictly speaking it means single exposures made in rapid succession or a camera speed of roughly one-eighth normal. In practice, however the term is used to designate anything from about half speed down to the slowest continuous exposures. It is accomplished in variable speed cameras by using the half speed drive and in hand cranked cameras by

turning the camera very slowly. In single exposure cameras it may be accomplished by making single exposures in very rapid succession.

EFFECT.—A traffic snarl is shown in which the various vehicles and pedestrians dart about at about sixty miles per hour, to the (apparent) imminent danger of their lives.

METHOD.—Set up the camera in the usual way and make the exposure at the slowest rate of exposure the camera is capable of. The slower the rate of exposure the greater the apparent speed upon the screen.

> CAUTION: As a slow rate of exposure means a greatly increased *time* of exposure, this must be taken into consideration in calculating the exposure to be given. If this is not done the stop motion picture will be badly overexposed. Stop motion has really few practical applications. In case a very slowly moving subject is being filmed, half speed may be used to increase the screen rate, thus saving film and keeping the subject from becoming monotonous, but aside from such effects, the manipulation has few except comic uses.



(*Courtesy Bell & Howell*)
The Filmo character title writer ready for operation.

ANIMATION.

Animation is a greatly exaggerated stop motion. In this work the exposure ceases to be continuous and becomes intermittent. Animation is one of the least often

used and one of the most potentially useful of all manipulations available for amateur use.

Through animation we make moving titles, trick titles, animated cartoons, moving diagrams, and similar effects. We can, through its use, infuse life into dolls, toys and other inanimate objects. We can endow the nursery toy chest with life, and we can make the characters in the comic sections take on semblance of life. We can make diagrammatic drawing go through the phases common to the mechanisms which they represent and we can show the frontiers of civilization being pushed over the surface of a map. In short, we can give automatic movement to any object, whether solid or plane.

As this is a phase of trick work rather than a specific element, we can hardly pause to consider even one each of the typical effects possible, so we will immediately take up the consideration of the procedure followed in animation.

The first requisite is a camera which will enable us to expose one individual frame of film at a time. Also, as most of this type of work will be done in the studio, proper lights will be needed. If the cinematographer has among his equipment the arc lights recommended for interior and title use, these will do admirably, but it is quite possible to make animation films by the use of lights of much lower intensity than would otherwise be possible, as an exposure of any desired duration may be used, so we may give five or ten or even thirty seconds exposure if necessary, but lights which allow an exposure of not more than five seconds will be found more convenient than less intense ones.

It is assumed that the subject has already been selected and that the background and properties are all assembled ready for work. The lights are set as is the camera, and everything is ready for the actual work of animation.

The next problem which confronts us is that of determining the amount of absolute movement to be given each object between each two exposures. This problem is hardly reducible to an exact arithmetical equation, but we may approximate the correct answer by comparing the motion with that of a normal human being. A soldier marching will take about two paces per second, covering a distance

of very slightly less than his own height. This takes sixteen frames of film. If we are animating an eight inch doll, we will give each stride eight frames, or move the leg one-eighth of a stride for each frame. These strides will be just less than four inches in extent for quick time, and for a more leisurely walk we will give the stride ten or twelve frames, covering about two inches. In this way we can adapt practically any normal motion to that of dolls, cartoons and so forth.

In connection with this determination it is always well to rehearse the act or a part of it. This will aid in arriving at proper motion determination and will also aid in securing proper synchronization of the motions of the various subjects and actors appearing on the screen. When the rehearsal is complete, make a test to see if the animation is natural. This test may be only four or five feet of film.

If these preliminaries are all good, you can start the real shot. Set the scene for the beginning of the act. Have your scenario before you. Start the lights going, make the first exposure and then start animation. Each actor or object which is to move is now moved slightly. The leg is moved through one-eighth or one-tenth of a stride, the arm is swung to correspond, and any other actor who is also in motion has the proper fractional part of a movement given to it. The second exposure is now made and the process repeated. With the completion of the tenth frame the doll should have been moved through one complete stride with corresponding motions.

When attempting this kind of work for the first time, it is well to make use of a piece of normal film of a person walking as a guide. This will give you a frame by frame model to follow in arranging the various positions of your dolls or other characters.

One of the most fascinating divisions of this work is the motion picture version of the popular "table-top" photography. With dolls and small figures which are so much in evidence these days, very amusing comedies may be performed with a row of books or other similar objects forming the background. In fact there is no practical limit to the variety or form which animation may take.

TIME CONDENSATION.

Time condensation is but an exaggerated form of animation. In animation the inter-exposure interval is determined by the time required to arrange the puppets after each exposure. In time condensation this inter-exposure interval is determined by the rate of movement of the object photographed.

Time condensation consists of so photographing any object that its apparent rate of motion upon the screen will be many times, even hundreds of times as rapid as it is in real life. Thus we can show a plant grow from a seedling to full maturity, bloom, fruit and die, and all in the space of a few moments. This variety of motion photography may be applied to any slowly moving object. It is diametrically opposed to slow motion, in that while the slow motion renders visible motion which is so rapid that it is invisible, the time condensation makes visible motion which is so slow that it is invisible. The most common use is such as that given in the example, the growth of plant life.

The matters of setting up the camera, arranging the lighting and so forth are the same as in animation. There are in addition a few points which must be considered.

This work must be done indoors. Provision must be made for admitting sunlight to the plant without moving it from its position in front of the camera. Both camera and subject must be arranged so that they may be left undisturbed throughout the entire filming of the subject, and the lights should have their positions marked so that they may be replaced with approximate accuracy for each exposure or series of exposures.

Let us make use of a specific example. Suppose we plant a bean in moist soil and wish to film its growth. We find, by experiment, that this particular variety of bean requires ten days for the amount of growth which we wish to show upon the film. We also find that it takes 48 hours for the sprout to thrust up the earth above it. We then plant a bean and prepare for the opening shots forty-eight hours later. We know that our film will be completed in ten days, but before start-

ing the actual work we wish to know just how much time will elapse between each two exposures.

We decide that we want this film to run about 4 minutes on the screen. That means one hundred feet or 4000 frames of sixteen millimeter film, in round numbers. We find that plants do not grow as rapidly during the night as during the day, so we decide to give double the number of shots per hour during daylight that we do at night, using six o'clock as the dividing line.

We will assume that inasmuch as we have 7,200 minutes of daylight and the same period of night, that we may take as a basis for our calculation 7,200 daylight units and 3,600 night units. (The night unit, remember, is twice as long as the day unit.) This gives us a total of 10,800 units to be filmed upon 4,000 frames. Therefore we divide 10,800 by 4,000 and disregarding smaller fractions we have 2½ as the quotient. As our basic unit is the minute, this gives us 2½ minutes as the basic inter-exposure interval.

This gives us 24 exposures per hour during the day and 12 per hour during the night. As we have 120 hours of each this gives us (120 x 24) plus (120 x 12) equals 4320. This is too much for this would require 108 feet of film and we do not wish to exceed our 100 foot spool, so we try three minutes. This means twenty exposures per hour for day and ten for night. Now (120 x 20) plus (120 x 10) equals 3600 frames of 90 feet of film, leaving just enough for errors and addition to the footage if this is found to be necessary.

Now, using a large face seconds clock such as a darkroom timer, mark the three minute intervals. As each one is reached make the exposure. If you forget one, make two exposures at the next interval, and if you take a half minute to turn on the lights, make the exposure and turn the lights off, you will have only 2½ minutes until the next exposure. According to this schedule an exposure is made every three minutes. This does not take into account the time necessary for the camera manipulation, which is automatically taken care of by the continuous motion of the clock hand.

High Speed or Slow Motion Photography.

Slow motion photography is so well known that a description of the effect is not necessary here. It may be

well to mention, however, that there are variations in the speed employed. We have so-called slow-motion pictures taken by almost every conceivable camera speed from double normal up to sixteen times normal in portable cameras and hundreds of times normal with the large research cameras. The first step then is to determine the rate at which the camera is to be operated. In this we have two considerations. The faster the camera speed the slower will be the screen speed, also the faster the camera speed the more film will be used per second. It is therefore no more than sensible to determine the slowest speed which will serve our purpose and to then use that speed for the conservation of film.

Rarely if ever will the amateur desire to use a speed greater than eight times normal, and in most cases this will be faster than really necessary. There will be many times when double speed will give just the desired amount of slowing. After a careful consideration of the needs in slow motion photography, it has been found that for amateur use, a speed of four times normal will give in the great majority of cases just the amount of slowing best suited to depict the action at its best without producing that peculiar nervous tension so often noticed in the spectator who is viewing an extremely slow motion film.

Leaving aside the reduction of standard negatives to sixteen millimeter positive, the amateur has three cameras available for making slow motion films. These are the Filmo and the Victor, and the DeVry. The Filmo double speed model is provided to make exposures at 16 and 32 per second, giving a half-time slowing. A special Filmo is also made which operates at 8 times normal speed only. This model can be used for nothing but slow motion pictures. The Victor camera occupies a position midway between these. It makes pictures at normal speed and at four times normal, giving in one instrument both normal and the most valuable slow motion speed, while the DeVry has similar speeds.

In chapter three we gave considerable space to the discussion of slow motion as applied to normal motion photography. To avoid repetition we will at once pass

over those phases and consider slow motion as it is used to supplement other manipulation or to secure obviously unnatural effects.

Many amateurs will be tempted to make shots of miniatures. They will carefully arrange railway wrecks and steamship disasters, and when shown upon the screen these shots will look just exactly like the original—toys! And, even with details obscured by soft focus lenses the toy appearance persists, and the poor amateur becomes disgusted with motion photography.

Tie a weight to a string one foot long and another to a string two yards long, forming two pendulums. Start these swinging. Which swings faster? In waves of water and in the motion of vessels, it will be seen that the larger the mass in motion the slower the rate of that motion. We can thus see that if we are to present miniature shots in a convincing manner, we must slow down the rate of motion. A sharply detailed shot of a toy boat taken at high speed, giving a slow, ponderous motion is far more convincing than a softened, detailless shot made at normal speed.

Slow motion is essential to the successful filming of miniature shots.

INSECT PHOTOGRAPHY.—There is another use for the slow motion process which holds infinite possibilities. This is the photography of insect life. For this work a complete set of Goerz effect accessories is essential.

This work is really a combination of low power photomicrography and slow motion. By the use of the Goerz reflecting focussing device, the lens mount is lengthened to a sufficient extent to permit the photography of objects only a foot or so from the camera. The prism enables the cinematographer to secure the most critical focus and to arrange the composition to suit his needs. The mask box gives him the necessary long sunshade and permits masking for double exposure making possible the introduction of human beings in the same frame with the huge insects. Hundreds of similar uses will suggest themselves to the amateur of inquiring turn of mind.

Photography From Moving Support.—The slow motion will also greatly improve films taken from moving railway train, automobile and similar locations. The extreme speed of the foreground motion has heretofore made these films anything but satisfactory, but by slowing them down, a much more satisfactory effect is obtained. Scenes of this character as well as panoramic films become beautiful examples of the motion picture art when made with slow motion, and for this purpose the slow motion camera will inevitably become popular.

There are certain phases of slow motion work which impress themselves upon us immediately. The fact that slow motion depends for much of its effectiveness upon contrast becomes at once apparent. In order to secure this it is essential that the slow motion shots be interspersed in the normal footage. This may be done in the editing as explained in the part of this book devoted to that work, but a camera which will take both normal and slow motion gives us a decided advantage in enabling us to make the shots in alternation as we desire and upon the same film roll. It is also a decided convenience to have the control so arranged that the change from one speed to the other can be quickly and easily made. In the Victor camera a half turn of the starting button accomplishes this result. In the Filmo a quarter turn of a speed control indicator on the front board does it. The DeVry speed change is as simply made. In neither camera is it necessary to open the camera or make any changes in the mechanism.

There is probably no phase of motion picture photography which is so interesting, which offers so many possibilities of infinite variation, which is capable of furnishing as much unusual information as the slow motion. The cost of the extra film used is negligible in comparison with the great benefits derived. For this reason the writer urges each reader to provide himself with a camera capable of making slow motion films.

Double Exposure.

Double exposure may be divided into two classes (a) those made without masks and (b) those made with masks.

The double exposure, and the multiple exposure (which is the same thing carried farther) makes possible many supernatural effects such as visions, ghosts, duplication of roles by a single actor and similar effects. Briefly it consists in exposing a portion, only, of the film, after which the film is rewound, the exposed portion of the film protected from light and the remainder or a second portion exposed. This is continued until the entire film has been exposed. Another form of double exposure consists of exposing the whole film, and then, after rewinding, making a second exposure upon the same (exposed) film.

DOUBLE EXPOSURE WITHOUT MASKS.

EFFECT.—A man is discovered sitting in an arm chair, smoking. The room is dimly lighted, and the walls of dark color, possibly wainscoted or panelled in dark oak. Suddenly a ghostly, transparent figure is seen at the rear of the room. While distinctly apparent, this figure is sufficiently transparent for details of the background to be seen through it. The man looks at this figure, jumps from his chair, thrusts his hands at the figure while turning his head away. The figure vanishes and the man sinks into the chair.

METHOD.—This effect is slightly more complicated than the preceding tricks, but quite within the ability of the careful amateur. This scene is made "by count." That is, the motions of the actor are made at predetermined periods which are shown by means of a seconds timer. One of the most useful accessories for this work consists of a large or "giant" type of interval timer. This is a clock with a face ten inches or more in diameter, and with a single hand which makes a complete revolution in one minute. This is hung where both cameraman and actor can see it. The actor goes through his action in rehearsal. The clock is started at the beginning of this rehearsal and upon a card the cameraman notes the clock reading as follows (a) appearance of spectre (b) actor sees spectre (c) actor rises (d) actor thrusts his hands at spectre (e) spectre disappears (f) actor sinks into chair. Note that in this rehearsal the spectre does not appear, so entries (a) and

(e) are entered at those periods which the action of the actor makes most appropriate.

Now the camera is prepared. The film is threaded and the leader wound up bringing sensitive film into the gate. The lens is removed and the film which is exposed in the aperture is marked with a pencilled cross or other mark of identification. The camera is now set up for the scene.

The camera is started. About two seconds after the period (a) has passed, the cameraman calls out "Look!" the actor looks up and sees the spectre, when period (c) comes the cameraman calls "Up!" and the actor rises, at (d) the cameraman calls "Push!" and the actor's arms are thrust out. Period (e) passes without comment by the cameraman and at (f) the cameraman calls "Down!" and the actor sinks into his chair and continues with appropriate action. This completes the first exposure.

In professional work such effects are made by the "Foot and frame" method, where the actual frame passing through the camera may be selected, but if we are using a spring-driven camera in good condition we may assume that the film will pass through the mechanism at a practically uniform rate of speed and thus enable us to do this by time. But to allow for any possible spring drag it is advisable to allow a half second or so leeway especially between (a) and (b) and between (e) and (f).

The camera is taken into a darkroom illuminated only by a "safe" light. The film is removed and rewound upon the first spool. The camera is rethreaded and the film started through the camera. The film is advanced one frame at a time until the marked frame appears in the film aperture. Thus we know that the film will start at the identical point at which the first exposure was started. We are now ready to film the spectre.

A black drop is necessary for this work. Velvet is far better than any other fabric, but a good, dense black flannel or felt may be substituted. This should be hung against one wall of a room and all outside light excluded. At one side of this improvised dark stage is placed the

primary light, and directly opposite, making an almost perfect cross light is placed the secondary light. In this case the effective intensity of the secondary should not be more than one-fourth that of the primary. Both lights are shielded so that the black drop is not illuminated in the least. A black floor covering should also be used, and as far as possible shielded from the light. The strongest light should be thrown upon the head of the figure, falling off rapidly toward the feet. The actor who is to play the role of the spectre is clothed in a white or light colored costume, and has a white grease make-up.

The camera is now set up and the position of the actor determined. It may be remarked here that either a sliding base focussing telescope or a reflecting focussing device should be used in all double exposure work to ensure exact registration of positions. The exposure is determined in the usual manner and about half the proper exposure given.

The actor is placed in position. The hand is held over the lens and the camera started. When time (a) arrives the hand is removed from before the lens and the spectre starts action, at (b) the cameraman calls "Point!" The spectre slowly raises its arms at point (c) the cameraman calls "Beckon!" and the spectre motions the actor toward him at point (d) the cameraman calls "Laugh!" and the spectre laughs grimly and at point (e) the hand is placed before the lens and the camera stopped. This completes the photography and if the work has been carefully done the film will show the effect as first described.

> CAUTION: This effect depends upon the fact that dark objects affect the emulsion very slightly. If the room has dark walls, the greater portion of the wall will not affect the emulsion at all, but the few details which reflect highlights make us believe that we see the entire wall. In fact the emulsion is as virgin as when placed in the camera. It follows that if we expose this same film upon an object which is white and therefore actinic, this emulsion will receive the image. This is just what occurs. The few highlighted details show through the spectre giving the illusion of complete transpar-

ency. Therefore it is essential that the portion of the first scene in which the spectre appears shall have a very dark tone while the second exposure be against black, *i. e.,* no detail whatever of the second scene shall be registered except for the spectral figure itself. The graduated lighting makes the spectre's feet inconspicuous and gives an appearance of a ghostly glide to the actor's motions. This effect is, as others, subject to infinite variation giving the possibility of securing both mysterious and beautiful effects.

A pair of complementary masks for making double exposures. The white line in the second mask is shown only to indicate the outline of the opening in the mask box, showing the effective area of the mask.

Double Exposure with Masks.

EFFECT.—Again a man is discovered seated in his arm chair idly smoking. The smoke drifts up and forms a faint cloud in the corner of the frame. This cloud shifts and changes its form, a vision appears and we have two pictures shown upon the screen simultaneously, one the actor as he is, the other his dream. He shakes his head, raises his hand and draws it across his forehead and the vision disappears.

METHOD.—This is made in much the same way as the preceding. That is, the film is marked, the first exposure made by count, the film rewound, the second exposure made by count and the film is finished. In this case the periods are: (a) beginning of film (b) the appearance of the vision (c) actor sees vision and smiles (d) brushes hand across forehead and (e) disappearance of vision. As for mechanical reasons periods (d) and (e) cannot occur simultaneously, the effect in reality is that the hand is drawn across forehead and dropped to the lap while the actor's eyes remain closed. He shakes his head and raises his eyes, but the vision is gone. The principal point to be

observed in this work is that when the cameraman calls "Hold!" the actor shall remain absolutely motionless until told he can move.

The camera is set up and started. When (b) is reached the cameraman calls "Hold!" and stops the camera. He inserts the protective mask and starts the camera calling out "Action!" The vision is now supposed to be present and the actor carries on in accordance. He looks up, smiles and looks at that part of space before him which lies in the general direction the vision will occupy later. At (d) the cameraman calls "End!" and the actor raises his hand to his head, then at point (e) the cameraman calls "Drop!", "Hold!" in quick succession, and stops the camera. The mask is removed and action resumed to the end of the scene. We now have a film upon which is impressed the image of the actor, but for a part of the film's length, a portion of the frame has been protected from the light and there is no image upon it. We now have to register the image in this space.

The film is rewound in the darkroom or changing bag as before and the marked frame brought into the aperture. We arrange the set for the action of the vision. The camera is set up for this action and the complementary mask inserted. The action is arranged so that it will appear properly in the space exposed by this mask. The camera is run with the hand over the lens to period (b) when the hand is removed and the action carried on. This runs along to period (e) when the camera is stopped and the film is completed.

In this work one must clearly understand the function and use of the complementary masks. These masks are pieces of black cardboard so cut that when laid, one upon the other, that they will be opaque, yet in no place will there be a double thickness of the card with the exception of the narrow line of junction of the two openings. Thus if mask (a) used for the first exposure has the bottom half and the left half of the upper half cut away, leaving only the upper right quarter of the cardboard in place, the complementary mask will have the lower half and the upper left quarter of cardboard with only the upper right quar-

ter open. All space which is open in one is closed in the other. This allows us to expose any desired portions of the film separately.

The Goerz mask box for amateur ciné cameras is made especially for use with these masks. There is a frame boundary already provided so that all that is necessary is to insert a piece of cardboard, mark the outline of the entire opening, remove the card and cut away any desired portion. From this first mask a second is made as its complement and the masks are ready for use. It is well to make a registration mark on both masks and upon the mask box so that the two masks may be inserted into the mask box in correct lateral register. The sliding base arrangement enables one to check up on the correct placement of the two scenes of action in order that they may appear properly matched upon the screen.

While double exposure seems to be quite complicated, it is not really so and with a very little practice the amateur should become quite expert in its use.

DISSOLVE.

The dissolve is a very beautiful effect, but it is perhaps the most difficult effect for the amateur to use as it requires a great deal of practice. Due to the automatic drive of the amateur cameras, its use is tremendously simplified, but even so, and with the aid of a tripod for camera support, it is difficult to make a smooth dissolve in a predetermined time.

> Dissolves are accomplished in professional practice by means of special double shutters which close by means of a gear train, but in amateur work, the dissolve is accomplished by turning the iris diaphragm *of the lens* toward the closed position. In making any scene which includes a dissolve it is best to make use of a filter in bright light as the larger the diaphragm opening to start with the easier it will be to make a smooth dissolve.

Before trying this on an actual shot, it is a good idea to practice with the camera, opening and closing the diaphragm several times until it can be closed with a uniform

motion and in a predetermined time, usually about four seconds.

EFFECT.—The dissolve is responsible for the screen effect which we know as the "fade." The scene gradually dies away into blackness. These straight fades are comparatively easy, but when we get into the "lap dissolve" and the various lap effects, we find unusual accuracy is demanded. Let us consider our last double exposure effect. Here the vision instead of appearing suddenly would slowly take form and as slowly die away instead of disappearing abruptly.

METHOD.—In this case the difference would affect only the periods (b) and (e). At the first call of "Hold!" the actor "freezes" and the cameraman instead of stopping the camera, turns the diaphragm down through a period of three or four seconds. The mask is inserted and the camera started and the diaphragm turned to the open side. The action is then continued and at the end of the vision the same thing occurs.

In filming the vision the same procedure is followed. The lens is covered until the portion of film between the two dissolves is reached. Then instead of merely removing the hand, the iris is opened on the vision and at the end of the scene, the iris is closed upon the scene and the camera stopped. This substitutes the dissolving vision for that which jumps in and out of the scene abruptly.

CAUTION: This effect can be obtained only when the film is to be finished by the negative-positive method as the negative must be cut between the two dissolves, the dissolve *in* registered over the dissolve *out* and the positive printed from both negatives simultaneously. This does not give as smooth an effect as is obtained when we can run the camera in reverse, but the effect will be good enough to add appreciably to the general quality of amateur production. If this is done with a film to be reversed, the same splice would have to be made which means that at each lap approximately eighteen inches of double thickness film would have to run through the projector and this would present great problems in registration and joining.

EFFECT.—(b) A statue is shown which gradually loses its lifeless character and turns to a living model.

METHOD.—A straight shot is made, dissolving out on the stone statue. A living model is put into the place occupied by the statue and the dissolve opened upon her. In this case, where the entire frame is involved in the lap, a darkroom rewind is permissible placing the lap directly upon the single negative. The dissolve is made in five seconds (2 feet of film). The position of the statue on the ground glass of the reflex focusser is noted and the camera taken to the darkroom and two feet of film rewound. The camera is then set up and focussed upon the model who is placed in the same relative position that the statue occupied. The exposure is now made opening the iris during five seconds and the scene is carried on. In this try to have the statue and model only sharply focussed. Let the background be highly diffused, as this obliterates any mistake in registration during the second set-up of the camera. The lap dissolve may be adapted to any case in which one scene or a portion of a scene is to be gradually merged into another of different character.

DISSOLVE, ROUND CLOSING.

This is an effect which is improperly called a dissolve, as there is no suggestion of dissolution in the projected image. It is more properly called the "Circle" or "Iris" and is used in conjunction with the words "in" and "out," as "circle in," "circle out," "iris in" and "iris out."

EFFECT.—The picture is presented upon the screen in the usual manner. At the end of the scene instead of stopping abruptly, the edges of the screen become black leaving the scene presented in a circular opening. This circular opening, which has diffused edges, grows smaller, until the screen becomes entirely dark. The corresponding effect is shown when the scene opens with a black screen, in which a small spot of light appears. This spot gradually grows until the scene covers the entire screen.

This effect is also used to introduce characters, or to emphasise a certain character. Such character is placed (when using amateur equipment) in such a position

that his face will occupy the center of the screen. Then, it is obvious that this face will be the first thing seen on a circle-in or the last object seen on a circle-out.

METHOD.—This work requires the use of a special device known as the "Iris Vignetter." These are made by C. P. Goerz, Wollensak and Bell & Howell. Some of the earlier models did not quite close, a characteristic of all ordinary iris diaphragms, but the latest models have an extra leaf providing complete extinction. With the models which do not entirely close, the hand must be placed over the end of the iris when the circle-out is completed, and conversely the hand must be held over the iris until just prior to circling in. The iris itself is a small funnel shaped device attached to the outside of the camera in front of the lens. It has an iris of conventional form attached to its outer end, and this in turn is controlled by a small rod projecting from the control collar.

To circle in, the scene is first arranged properly either by use of the reflex focussing device or the sliding base arrangement. In this case the sliding base device will be the better as then the iris can be operated and the effect watched directly in the focussing telescope. This permits us to place any actor or any object in proper relation with the opening in the iris.

There is always the possibility of producing new effects with a pocketful of small optical accessories. Any optician will supply you with a prism. This should be of the right angled or "total reflection" variety, and about the size of those used in the larger prism binoculars or slightly larger. A second equilateral prism should be purchased, with a base of perhaps ¾ of an inch. A mirror of good quality, on thin glass and perhaps two inches square, should also be secured. These may be easily adapted to the front of the camera in such a manner that the various devices are supported before the lens in the required manner to produce the various distortion effects.

For example if the mirror is held at an angle of 45 degrees in front of the lens with its edge about one inch in front of the center of the lens, your film will show a pic-

ture in two parts in which motion is entirely dissociated yet with no apparent dividing line. Other effects will suggest themselves.

The prisms are used to secure curved line, "tumble down" effects, and for either horizontal or vertical compression effects.

One of the major uses of the prism is to secure "round-the-corner" films. By placing a total reflection prism before the lens with one of the shorter faces resting against the lens barrel and the other facing to one side, subjects may be shot at right angles to the line of the camera optical axis. This enables one to secure various shots in which the subjects are absolutely unconscious of the fact that they are being photographed.

This last device will be of the greatest value to the traveller who so often finds himself among people who, individually and collectively object to being photographed.

The field of camera trickery is boundless, and the amateur is cautioned before entering it, that it will become an obsession. Amateurs who are bitten by the dread trick bug become its lifelong slaves.

CHAPTER NINE

EDITING THE HOME FILM

We all talk glibly of film editors and cutters, yet how many of us really understand the first principles of film editing?

Film editing is analogous to literary edition. Superfluous parts of the film are removed, errors are corrected or removed, the component parts of the whole are rearranged to the best advantage, and in short, the film is assembled in its most coherent form by the editor. To this end, many parts of the original will be entirely removed, and quite often certain lengths of an entirely different film will be introduced for the purpose of making the original more interesting or more intelligible.

The first, and most general purpose of edition is the removal of the poor frames at the beginning and end of scenes. These will almost invariably show slight traces of fog, the action of the scene itself will probably not be of great interest, and we nearly always expose a foot or so after the action of interest has stopped. These uninteresting portions are removed. This is not merely a matter of choice, as such portions, if allowed to remain in the film, will cause an interruption of the continuity of interest on the part of the spectator and your friends will find your films rather a bore instead of being of great interest.

It is a fact well known to those who have had professional experience, that an experienced film editor could take the usual amateur film library and by editing each film make the entire series so interesting that they would be used constantly and projected repeatedly until worn out. This is quite different from the present usual case where a film is projected two or three times and then discarded.

Then, when making films of the family, or during a vacation, or when shooting an amateur photo-play there will be times when a scene is started and then proves a dud before completion. Such slips must by all means be removed from the film. So much, then for the removal of portions of the film.

Chronological Order.—Now we take up the much discussed question of the preservation of the proper chronological order in making the film. There has been considerable acrimonious discussion regarding this point, but mature deliberation will show that there is only one possible method of working which can be successfully applied to any film. The various scenes which go to make up an amateur (or professional) photo-drama should be taken in that order which presents the least technical difficulties! So, if it is more convenient to make scene number nineteen immediately after making scene number forty-two, that is the only sensible thing to do. The attempt to make the scenes in proper chronological order will practically always result in a film of inferior quality.

It has been argued that the amateur actor can do better work by carrying on his action progressively, that in using the non-chronological order he will forget the preceding scene and be unable to take up the proper action. Nonsense! Common sense will indicate that all scenes of a sequence will be taken in order if the location does not change, so that each individual thread of action may be carried on practically continuously, but even if this is not true, the actors can easily check their scripts and get into the swing of the action. Discrepancies in acting are not nearly as noticeable as discrepancies in costumes or properties and these will inevitably creep in where the chronological order is followed.

The successful amateur photo-play will nine times out of ten be made in other than natural order. It is therefore the duty of the editor, not only to cut the scenes apart, but to reassemble them in *order* and in a *manner* which will give a smooth, flowing action to the entire sequence. Note that it is not enough to merely re-assemble the films in proper chronological order; they must also be assembled

(or edited) in a way which will compensate for errors in action!

The amateur cameraman has not the facility in changing magazines which the professional has. Therefore, as there are often interesting shots cropping up which have no relation to the story being filmed, the cameraman will go right ahead and grab these shots when the opportunity offers. No matter what they may be, if they have promise of future interest, shoot! Later, when the film is being edited this shot will be cut out, labelled and stored in the film editing library. Note that this is quite different from the film library. The latter is a collection of complete films kept on hand for purposes of projection. The editing library is a collection of individual shots to be used at some future, indefinite date for the purpose of adding interest to a film which is being edited.

When the amateur photo-play is being edited there will always be times when the need of some scene is felt, which scene has not been included and quite often it is of such nature that it cannot be secured without great trouble and expense. Suppose, for example that the cinematographer lives in Tampa. One sequence is built about a honeymoon spent at Niagara. He could hardly be expected to go north merely to make this shot. However, suppose that on his vacation last summer he was at Niagara and secured some shots of the Falls. These would be placed in his editing library and in this photo-play he could cut in one or more of these shots to excellent advantage.

Therefore the editor will not only watch for opportunities for inserting library shots, but when travelling he will always keep a weather eye open for such material.

Illusion in Edition.—This brings up another point of edition, and one of the more difficult ones. That is the deception of the audience by the approximation of inter-related shots to produce an illusion of a scene which cannot be projected for one reason or another. To illustrate this point we may as well continue to use the Niagara example.

We build a railing similar to that found at or near the point from where the shot of the Falls was taken. This is arranged so that the background is hazy and formless. We

place our actors before this railing, and one of them points out into the distance. A sharp cut is made to the Falls shot, and back again to the actors. One points in a different direction and again we cut to a short shot of the Falls from a different angle. If these shots are properly arranged, in spite of the fact that one series was made in Florida and the other in New York and Canada, the spectator will firmly believe that the whole series was shot at Niagara.

This cutting trick is often used in professional work to lend reality to miniature shots of catastrophes, and it is one of the most valuable tricks which the amateur editor can use. He will be able to produce effects which will be inexplicable to his friends. Even when they know that there is some kind of trick involved they will not be able to analyze it, so great is our mental power of association of ideas.

When the library is built up to a sufficient size it will often be possible by the clever use of titling to assemble a complete photo-play or review reel from these unrelated shots. This has actually been done in professional work.

Sequence and Tempo.—A knowledge of sequence and tempo is essential to cameraman, editor and director, but as these three are usually the same individual in amateur practice, it will not be out of place to discuss these points here, as they have a very great influence upon edition.

Sequence.—A photo-play is made up of individual scenes which are assembled in a series of sequences which in turn make up the complete drama. Reels are merely mechanical divisions and are disregarded both in filming and in editing. A scene is one bit of continuous action. A sequence is a series of consecutive scenes. A change of time, place or theme means a change of sequence. Suppose that we are filming "Bobbie's First Day at School." The first sequence will show Bobby being prepared for school. This sequence will continue until he leaves home and starts for school. As he walks down the street we will fade out or iris out. The next scene will show him entering the school grounds. We circle or fade in on this shot. All of the scenes which show his activities at school form

another sequence if uninterrupted. But suppose we show Mother at home thinking of Bobby. We iris out on Bobby seated at his desk, iris in on Mother, complete that scene, iris out on Mother and iris in on Bobby just where we left him. In this case the scene showing Mother forms a complete sequence in itself. The sequence is always properly introduced by a fade in or iris in and closed by the opposite fade out or iris out.

This convention aids us in following the theme of the story, but it also adds considerably in another and incidental way. In film assembly a dark and light scene should not be placed in abrupt juxtaposition. As sequences often end in interiors and the next open on a bright exterior, the fade or circle prevents the optical shock felt when a dark scene cuts abruptly to give place to a light one. When this change occurs in the midst of a sequence, do something to break it. You may cut in an insert, or a short title. Anything which can be used to make this light change less abrupt should be done, but do not, in taking the film, deliberately insert circles or fades to give this gradual change.

Tempo.—Tempo refers to the rate of *action,* and not to the rate of travel of the film through the camera. It also refers to the style of editing. Let us consider two scenes, the first a scene of great excitement, such as a fire. The second scene is one which is peaceful and calm, a sunset scene in a rural setting with a country lass walking down a lane and out of the picture.

In scene one every actor is hurrying, rushing to the fire. A strolling actor taking his time would introduce a comedy effect here. All is speed, action! In cutting the scenes of such a sequence, the scenes are cut abruptly at the end of the principal action. Let us suppose that we have an actor in a leading role running toward the fire. We cut one scene as he leaves the frame, perhaps even while a part of his foot is still in the scene. We cut the next shot where he is part way within the frame, we lose no time, but actually gain a fraction of a second in this cut. This keeps the spectators "on their toes" and induces a nervous tension in keeping with the nature of the scene.

On the contrary, with our girl walking down the lane, we let her leave the screen entirely and then we run for a second or so on the empty scene and slowly fade or iris out, taking from five to eight seconds to complete the fade. This slow termination leads the audience,. mentally, into a condition analogous to the action, one of calm and peaceful contentment.

These points concerning tempo may sound like splitting technical hairs, but in actual practice their observation will inevitably result in your films becoming known as being interesting while Jones, across the street, cannot get his friends to look at his films which are carelessly edited or not edited at all. The superiority of professional films lies not so much in superior acting nor in superior photography, as it does in the great attention given to the edition.

Regardless of subject and all other points, the successful amateur film must be well edited!

Close-ups.—The importance of the close-up in photoplays can hardly be overestimated, but their effectiveness is often lost by improper placing. Whenever possible it is better to shoot a scene straight through and then make all close-ups for that scene after shooting the scene itself. These close-ups are then inserted in their proper position by the editor. Note that this placing is done only after the editor has seen the entire scene actually projected upon the screen. This makes it possible to place the close-ups to far better advantage than when they are shot in the places they are to occupy. When the close-up is shot in place it can be changed only with difficulty for if it is removed the two-scene portions of the film will not match. This causes a "jump" which is instantly apparent upon the screen. So for the best results, always shoot every scene in its entirety and then make the close-ups for insertion during edition.

If the actor is speaking during the cut, have the close-up showing the lips moving. Notes of such details are made during the filming of the scene, and the close-up later made to match.

Inserts.—In inserts, such as letters, telegrams and so forth, have the insert match the original as to color, shape

and position. Also be sure to insert this just at the proper place. It would be poor edition to show a letter, then the insert of the message and then back to the scene showing the actor opening the envelope. It is just as bad to have him lay it down after reading and to then present the insert. In such a case the scene should show the actor raising the letter and starting to read—then cut in the insert.

In flashbacks, there is somewhat more leeway regarding the place of cutting, but it is advisable to lead up to a point just preceding the crisis of the scene, then flashback and then back to the crisis.

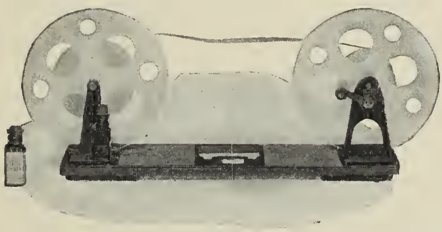
Titles.—Titles require careful cutting. The position of captions or descriptive titles is largely determined by the scene, but the spcken title must be inserted with the utmost care. The spoken title should be inserted when the actual speech is about two-thirds completed. This lets us know in advance that the actor is speaking, and the remaining one-third gives us a slight preparation for the succeeding action. A few trials in cutting in spoken titles will soon give you the necessary knowledge for doing this successfully.

Cutting Table.—So much for the "what" of edition. We will now consider the "how." The first step in editing is to provide the necessary place and equipment. The cutting table should be in a light, well ventilated room, for the work is more or less tedious and the greatest personal comfort should be secured. The table itself should be about two by three feet and about 28 inches high, or slightly lower than the usual household table. In the top of the table a square opening is cut about two inches square, or it may be rectangular, about two inches wide and from eight to twelve inches long. This opening is fitted with a piece of heavy glass such as is used for automobile windshields. The glass is set so that its top is just flush with the table top. The crevice between the glass and table top is filled with some plastic material which will give a smooth even surface when dry. Beneath this glass a socket is fixed which will take an ordinary 25 watt electric bulb. This glass makes it easy to examine film

1. Editing the film using the cutting rack, with rewind and splicing machine. The projector is used to project titles making them easy to identify.
2. Loading the Stinemann 16 m/m rack preparatory to developing.

without having to hold it up toward the light which is often awkward. With the glass in the table top one can examine every frame in a spool of film without fatigue. It is well to insert a piece of paper or ground glass between the bulb and the glass to diffuse the light.

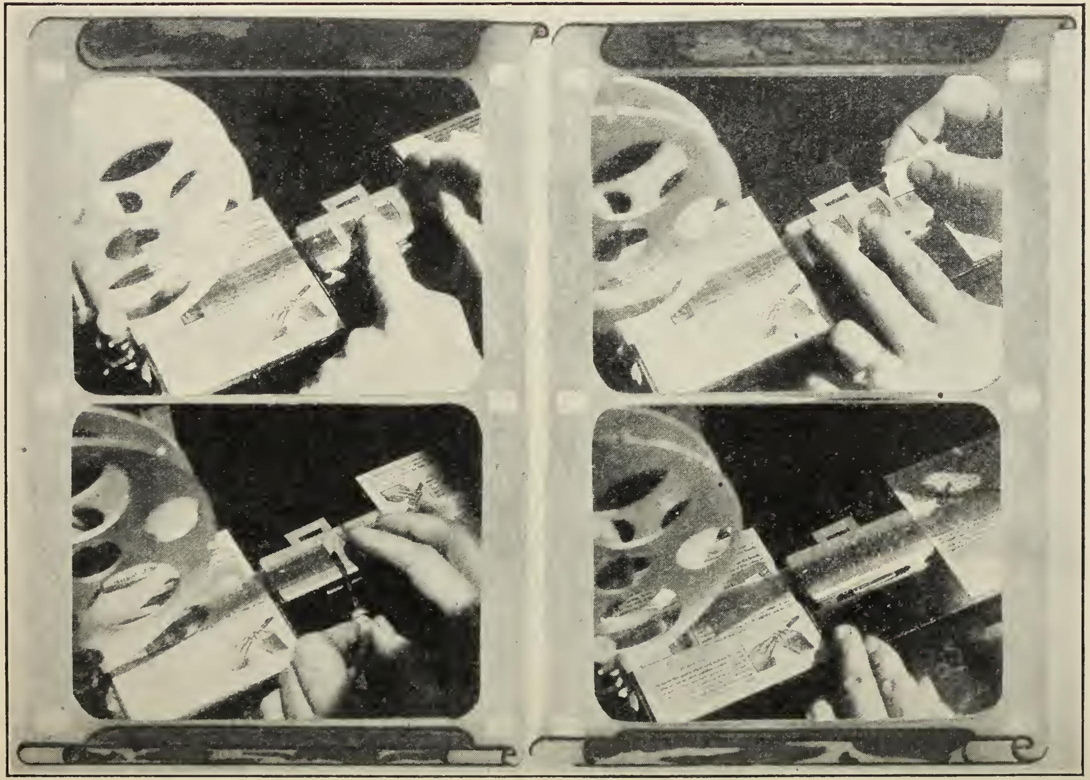
This table is to be equipped with all accessories for edition. The importance of such equipment cannot be overestimated. In fact, if I had only a certain limited sum to expend, I should rather purchase a less expensive camera and buy a good set of editing equipment than I would to buy an expensive camera and do with makeshifts in the cutting room. The finest film ever made can be ruined in editing, and this holds true of amateur films just as much as of professional ones! Do not skimp the cutting room! The best equipment is not expensive and it will mean a 100% improvement in film quality.



(Courtesy Eastman Kodak Co.)

Kodak rewind. This is an essential part of the furnishing of any amateur cutting room.

Rewinds.—The first thing to consider are the rewinds. Do not try to use a pair of wooden uprights with nails driven through them. After turning the reels by hand a few times, and after picking up a reel which has dropped from the nails a few hundred times, you will be strongly tempted to throw the whole thing out of the window and go fishing. Get a set of geared rewinds! You can get along nicely with one geared head and one dummy, but for de luxe cutting, get two geared heads. This is strictly a luxury, and has no great advantage except that the film may be run in either direction at high speed. It is a common practice in professional cutting rooms, but for the careful amateur, there are few rewinds which will give more thorough satisfaction than the type manufactured by



THE KODAK SPLICING DEVICE

1. Cutting the film.
2. Scraping the film.
3. Applying the cement.
4. The completed splice.

the Eastman Kodak Company for use with their standard sixteen millimeter, four hundred foot reels. This is the rewind used by the writer in editing his sixteen millimeter film and it gives the same consistent satisfaction that is characteristic of Eastman products. The general appearance of this rewind set is shown in the accompanying illustrations.

This rewind consists of a base of hardwood, weighted by the use of metal plates under each end of this base. These plates bear rubber feet which prevent the instrument from marring the finest furniture. At the left end of the base is a dummy. This is a support with a freely turning shaft which in turn is made to take the standard 16 millimeter reel or the standard camera spool of either 50 or 100 foot capacity. At the right end of the base is the geared head. By means of gears enclosed in this support, the reel is turned much more rapidly than the crank, making it possible to use this rewind set for rewinding films at a high rate of speed when using a projector not equipped with an automatic rewind.

(*Courtesy Eastman Kodak Co.*)
The Kodak Splicing Outfit. This small pack contains all of the essentials for splicing 16 m/m film.

In the center of the base is a very simple, yet very effective, film splicer. This consists of a metal base in which are set eight pins. These pins engage a similar number of perforations in sixteen millimeter film. In addition a metal shield is provided which is laid upon the film and registered by these same pins. One end of this shield is marked "Cut" and one is marked "Scrape." The film is placed, emulsion side up so that the pins enter the perforations. See that one entire frame extends to the right of the right hand pins. Now place the metal shield over this film with the end marked "Cut" to the right. Using

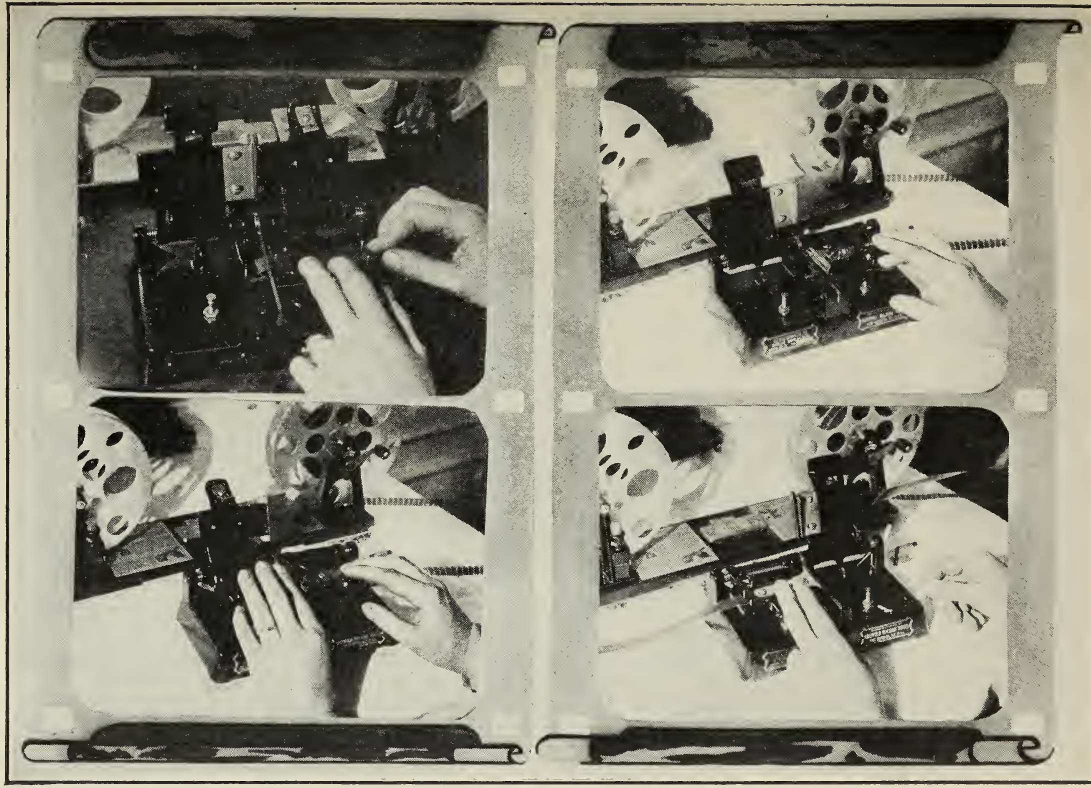
the edge of the shield as a guide, cut off the torn edge of the film. Lift the shield and turn it end for end with the end marked "Scrape" at the right. A narrow edge of film will be exposed. Moisten this edge and scrape the emulsion from the film. Be sure that all emulsion is removed. The film and shield are now removed from the metal block.

The film which we have cut and scraped we will call the left hand film.

Now take the other torn end. Place it, dull side down so that one entire frame extends to the left of the left hand pins. Place the metal shield over this as in the first example, with the end marked "cut" to the left, and cut off the torn piece. Then remove both shield and film from the block. This we call the right hand film.

Replace the right hand film, emulsion side down over the four right hand pins only. This will bring the cut end in the center of the block. Place the left hand film, also dull side down over the four left hand pins. The scraped end of this film will now project over the end of the right hand film. Hold the films in place with the first and third fingers of the left hand. With the second finger of this hand lift the scraped end and apply a liberal coating of film cement to the under side of the scraped end, press the two ends together and hold for about ten seconds. Then remove the film from the block, press the joint between the fingers and wipe off any surplus cement.

Splicing Film.—This splicer is thoroughly satisfactory for film repair and occasional splicing, but for the extensive splicing necessary in film editing, a more elaborate machine will be found to be convenient. There are numerous splicers on the market, some very good, some good and some not so good. All of them will make a splice which will ride through the projector, but that is not enough. We want splices which will run through the projector without any indication of their presence. Only this kind of splice will insure long life to both film and to projector. A poorly aligned splice may go through, but it imposes a strain upon the film and this in turn places the mechanism under a strain. Such continuous and repeated strains mean wear or breakage of the projector sooner or



GRISWOLD MACHINE SPLICING

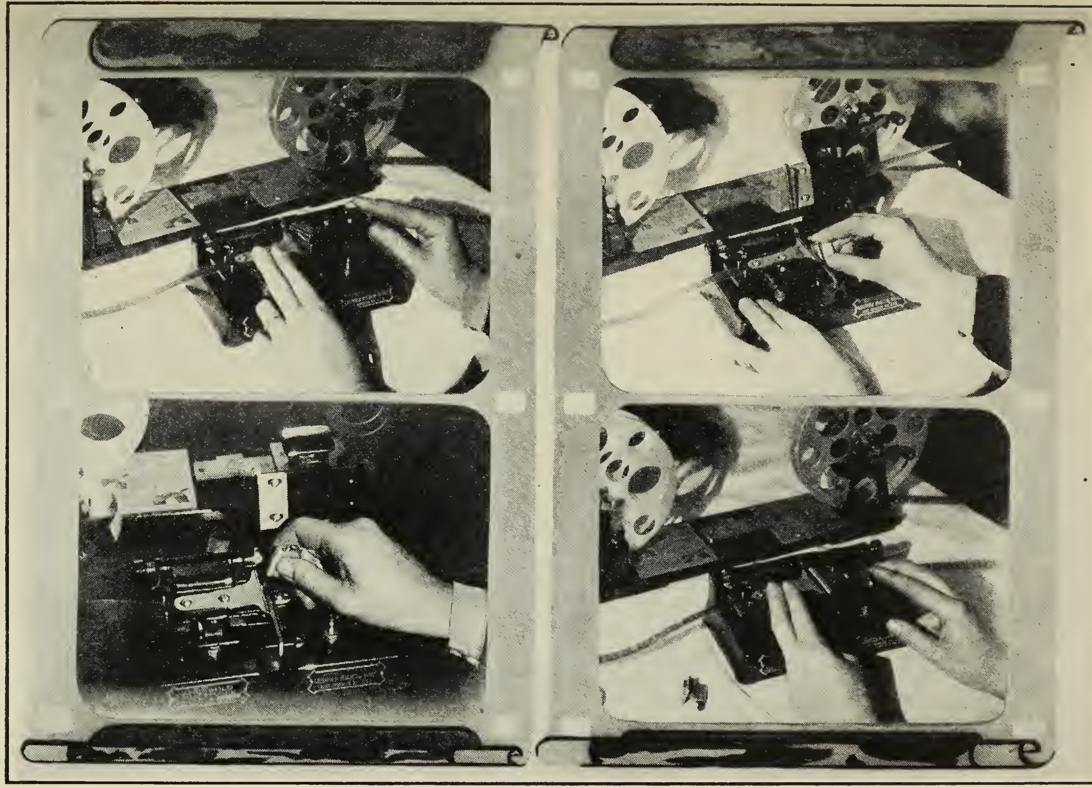
1. Placing the film in the machine.
2. Clamping the first film.
3. Shearing the torn end.
4. The second end in place.

later. The best type of splicer is that which is modeled upon the professional machines. These are but little more expensive than the cheap machines, and mean perfect patches. The writer has used a Griswold splicer of this type for some time and has found it to be fully satisfactory in every way. This splicer, which may be regarded as typical of the professional type of splicer is used as follows:

The splicer consists of two pair of leaves, right and left hand, placed on opposite sides of a shear blade. The leaves may be moved independently or in pairs. For reference we will call these leaves upper left, lower left, upper right and lower right. The directions are those of the operator who faces the machine.

The left pair is raised, also the upper right leaf. Upon the upper surface of the lower right leaf are three pins. Two rounded at the right end and one pointed at the left. The film is placed, emulsion side up between the two right hand pins, while the single pin at the left is inserted through a film perforation. The upper right leaf is now lowered. This clamps the film firmly between the upper and lower leaves of the right pair. A double spring holds the film firmly upon the shear blade at the left of the right pair. The lower left leaf is now lowered. This shears off the end of the film clamped between the right pair of leaves, leaving it squared for a neat joint. Leaving the lower left leaf down, the right pair is raised, carrying the right hand piece of film with it. The other piece of film is now placed upon the lower left leaf just as was done before, the upper leaf brought down, clamping the film in place. The right hand pair is now brought down, which is turn shears the end of the left piece of film. The right pair is raised again disclosing the sheared end of the film lying upon the shear blade. If the operation has been properly performed, there will be a pair of perforations lying directly upon the shear blade. About 1/16th inch of film is exposed.

Now the accessories supplied with the machine come into play. These consist of a felt moistener, a brush and a scraper with extra blades. The felt moistener is soaked in



1. Shearing the second end.
3. Brushing the film.

2. Scraping the film.
4. The splice completed and under pressure.

water until it will absorb no more. It is then squeezed fairly dry and is ready for use. The exposed end of film is now thoroughly moistened by rubbing the moistener back and forth across its surface. The scraper is now laid upon its support rod, just beneath the shear blade. To bring the scraper blade into contact with the film, the scraper must be tilted to the best scraping angle. Moving the scraper back and forth, tipping it toward you as you draw the blade toward you, and tipping it away as you push, the emulsion is rapidly and completely removed from the celluloid. Any fragments of emulsion or celluloid are removed by means of the brush set in the scraper. The scraped and brushed film is given a coating of cement, not enough to flow off, yet a sufficient amount to leave the film thoroughly and apparently wet. The right pair is now brought down as far as it will go. This clamps the celluloid surface of one piece of film to the cleaned patching tab of the other, completing a good joint. This joint is made so near the frame line and is made so accurately that there is no screen indication of its presence other than the change of scene.

A skilled operator can make good splices on such a machine, in fifteen seconds, but any average amateur will have no difficulty in making a joint in thirty seconds. That means from the time the two cut or broken ends are picked up until the joint is placed under pressure. Of course, if the pressure is maintained for ten or fifteen seconds there will be less chance of the joint pulling apart. However if a joint holds for a half minute, it will probably hold indefinitely. To understand this we should consider the joint itself.

Film "cement" is not an adhesive of any kind. It has no adhesive effect upon anything except celluloid. It is in fact a mixture of celluloid solvents, usually acetone and amyl acetate, although ethyl acetate is also used. In this mixture a few shreds of old film are dissolved to "ripen" the cement. It is evident that if a solvent is placed upon celluloid that the process of solution will start at once. The first step in such a process is a general softening. This occurs in the film patching. This softening is a com-

paratively slow process, so that when two pieces of celluloid are placed under pressure with celluloid solvent between the pieces, the surfaces of the celluloid strips are softened and the pressure forces them together, in a way actually welding the two pieces together. Then, as the film solvents are extremely volatile, this phase is followed almost instantly by a re-hardening or "setting" of the celluloid. Thus we see, that film patching must be carefully done. *All* emulsion must be removed from the surface of the celluloid which is to receive the cement. This means that an efficient method of cleansing must be employed. The old razor blade, especially in the hands of the novice, tore the film or wore it too thin before all the emulsion was removed. Machine work means the removal of all emulsion with a minimum amount of celluloid being removed. Then, it is also evident that considerable pressure must be applied instantly and simultaneously to *all* parts of the joint. This too is provided by machine work. For this reason film will break in a fresh place before a machine joint will pull loose, while the hand patches of the novice often pull apart before the film is projected. This is due to the fact that uniform and instant pressure is not applied as soon as the cement is laid on the film. As a result the film is held together not in a firm, unyielding joint, but merely by a few spots of surface adhesion.

The hand patch can be made when desired. In this case a diagonal cut may be made if preferred, as it will distribute the strain between an entire and a patched perforation. The film is cut from a point midway between two perforations to a similar point between the next two perforations on the opposite side of the film. The adjoining film end is cut to match this. Thus when the two films are laid, one upon the other, with the perforations matching there will be an overlap equivalent to one frame. This may be trimmed down to half this width if desired, but not less. The emulsion is scraped from the lower film by the use of an old razor blade. The emulsion must be entirely removed, yet care must be taken not to weaken the physical body of the film too much. When this is done, cement is applied to the lower film end, and the other piece which

was cut to match is laid upon this, the perforations quickly registered and the two films pressed firmly into contact with the fingers.

So much for splicing. A few trials will enable you to make machine splices of professional quality, and you may, in time, learn to make hand splices which are thoroughly dependable, but few amateurs can do this.

One of the most convenient accessories of the cutting room is the cutting rack designed by the writer of this book. This rack folds compactly into a space about 2 x 4 x 20 inches, yet it provides ample support for the scenes from a complete roll of film. A crossbar 18 inches long is supported about 20 inches above the table. This crossbar carries a number of spring clips which hold the film ends. This rack is clamped to the table's edge. A later addition is a square holder which slips over the rack feet, replacing the "C" clamps. From this holder hangs a velvet lined bag which keeps the ends of the film strips from dropping to the floor where they may be damaged.

Cutting.—The film is cut into separate scenes. Each of these scenes will bear its proper number registered by means of the slate or scene register. The scenes are hung upon the clips of the cross bar of the cutting rack. The ends of the film then hang in the bag and are protected from injury. As each 100 foot spool will contain approximately 250 seconds of screen action we may roughly estimate the number of scenes at from twelve to fifteen. Fifteen clips will give us one clip for each scene. If we are editing a complete reel of 400 feet we will have four scenes for each clip. Thus 1-2-3-4 will go on clip one, 5-6-7-8 on clip two and so forth. The bar should have the clips numbered for ready reference.

As the film is cut the individual scenes are hung upon the proper clips. When the whole film is cut, the titles are also cut and hung upon the opposite end of the bar. The film is now ready for edition.

Joining.—The main title is taken from its clip and the beginning or top end of the strip is threaded into the reel upon which it is wound. To the end of this strip the end

of the cast and credit titles are secured in proper order by means of small paper clips of the round variety which will wind upon the reel easily. To the end of the last title of the introductory group, the beginning of scene one is attached, and so on throughout the film. The titles are inserted in their proper places by referring to a copy of the scenario which should lie before the editor at all times. Omit all spoken titles at this time, as they are to be inserted later. When the film is complete, rewind it in a reverse direction and note carefully two things. See that the dull side of all scenes is upward or that it is downward. Do not have part of them one way and part the other. For the best cutting, the dull side of all scenes should be up. Note also the direction of the top of the frames. If the first winding is made upon the left hand reel, as it should be, the heads of all actors and tops of all letters in all scenes should be at the left of each frame. Be very careful to see that this is true. Now rewind again toward the left. Verify the order of the scenes, then cut off the identification, fogged frames and other spoiled frames. When this is done start rewinding again to the right, cementing the films together, at each junction of scenes.

This step is known as the "joining" or "patching," and is done as has been described elsewhere in this chapter. The principal thing to do is to see that each patch is firm and tight. When this is done the film should be once more a continuous ribbon without any scene registers, solid black or white frames or other similar flaws, but with all of the action included.

This film is projected after this stage. First the subtitles are examined to see if they are in their proper places, then the action is watched to see what portions could be removed. If an actor leaves the scene empty, it is not well to run five or six seconds of such a scene, unless it is deliberately done for some particular effect.

At the same time entrances and exits are watched to see if they have become "crossed" in production. (See chapter on direction.) If an actor leaves at the left side

of the screen and another scene shows him in the continuation of that travel, this second scene should show him entering at the right and again leaving at the left.

This is enough for the first cutting. With the obviously surplus film removed and the more general points of technique checked up, the film is ready for the second projection. This projection is for the determination of the places for the insertion of the spoken titles. The scenario will show the approximate location for such titles. When this part of the film appears upon the screen, the actor's lips are watched carefully. A reversible projector will be of great advantage in this work. After closely examining the speech, the general nature of the action is noticed at a time when the speech is about two-thirds or three-quarters completed. This is the cutting point for the title. At first you will probably have to project for each one or two titles, but with practice you will become so familiar with this work that you can cut in a full reel of spoken titles with only one or two projections.

The film is removed from the projector and placed upon the rewind. It is wound slowly until the portion of the film is disclosed where the title is to appear. At this time a reading glass will be needed. Examine the film frame by frame until you come to the predetermined place for the cut. Cut the film here and join in the spoken title.

Spoken Titles.—There should be perhaps six inches more of this spoken title than is actually necessary for screen presentation. After the spoken titles are cut in the film is again projected. Watch the spoken titles carefully and see if each one of them comes at that point where one would naturally expect them. Remember that the spectator imagines the actor going on with his speech while the title is upon the screen, so do not have ten seconds of action, a two-word title and then five or six more seconds of speech action. Try to time the lip motion to the length of the title, and by all means have the actors use the identical words which appear in the title upon the screen! In this projection note the imperfections of the spoken titles only, and in the next cutting remedy these defects. Then pro-

ject the film for the last time. By this time you will have become thoroughly familiar with the film and you will notice the minutinae which make or mar the whole. Thus a final or "polishing" cutting will smooth out the whole film and you will have a motion picture record which you may exhibit to your friends with pride.

In the case of the usual film, this copy is the only one made. Therefore the editing is done upon the positive which will be projected. In case the two-film process is used, as soon as the positive is cut satisfactorily, the negative is cut to correspond. Then every print made from this negative will be an exact duplicate of the edited positive, eliminating the necessity for editing every positive made from the negative.

When edition is complete, the film is polished and stored. A piece of hard felt about 2 x 6 inches and ½ inch thick is covered with soft cotton cloth and glued or tacked to the rewind base. The film is now threaded upon the rewinds so that it passes this pad dull side down. A pad is made by folding a piece of chamois skin several times. This is saturated with alcohol, but not to a point where it will drip. As the film passes over the pad, the back or polished side of the film is briskly rubbed with the alcohol pad. This removes water marks, finger marks and other similar marks which would interfere with good projection. This is known as "polishing" the film. When it is polished it is wound upon a reel with the emulsion side out (if a print, emulsion in if it is a reversed print). It is wound firmly but not tightly enough to "cinch" the film causing "cinch marks." When it is wound upon the reel the end of the film is secured with a film clip, to prevent the film from unwinding.

The film is now stored in a humidor until it is wanted for projection. The humidor is a can or box, holding one or more reels of film, and provided with an absorbent pad. This pad is kept moistened. This in turn prevents the films from drying out and becoming brittle. It is essential that films be kept in a humidor of some kind, if they are to be preserved for any length of time. The humidor pad should

be examined at definite intervals to see that it is moist.

Before finally storing the film, be sure to label it in some way, either by writing the title directly upon the reel or by attaching a gummed label. Do not depend upon a label attached to the humidor can *only,* as reels are apt to become mixed during a full evening's projection.

CHAPTER TEN

HOME PROJECTION

All of the discussion which has preceded this chapter has had but one aim; the production of the best possible film. This film is necessary for projection and projection in turn gives us the final result, the image upon the screen. All of our labor is directed toward producing a perfect image in motion upon the screen. If every step up to projection is done perfectly and the projection itself is neglected, our labors will be rendered useless. It is, therefore, quite necessary that we give the fullest possible amount of attention to this question of projection.

In order to do this we must understand the principle of projection. Motion picture projection consists of projecting, by means of an optical system, an image of the film upon a screen. The screen which is used is light in color, which is to say, one which will reflect the greatest possible percentage of the light which falls upon it. A total reflection screen, if such a thing were possible, would be ideal, but as this is not possible by any known means, we have to use the nearest approach to the ideal which we can secure.

If we allow a pure white light to fall upon a surface which has a high reflection factor, we "see" that surface as an expanse of white surface. If we hold our hand between the light source and the surface we see a projected image or shadow of our hand. The fact that the hand obstructed certain light rays in their travel from the light source to the surface, made this image or shadow visible. So, projection, whether still or motion, is the projection of a beam of light, certain areas of which are obstructed to a greater or lesser extent by the silver deposit in the film, causing a corresponding diminution of the intensity of the

light reflected from the corresponding areas of the screen.

You cannot project an area of light of greater intensity than the screen itself directly illuminated by the light source!

If you use a medium gray screen your highest light will be medium gray.

If we return to our shadow analogy we find that as the hand is held nearer the light source and farther from the surface, that the outlines of the shadow become more and more diffused until finally practically all form is lost. This is due to the fact that the light comes from a comparatively large source. By holding black carboard in front of the light, and by piercing a small hole in this cardboard you will find that the sharpness of the shadow's outline is restored, but that the contrast between the shadow and the illuminated surface is lessened, due to the small amount of light passing through the hole.

(Courtesy Bell & Howell)
The Minusa projection screen in its case.

In projection we are confronted with the problem of utilizing the greatest possible percentage of the original light, at the same time securing the sharpest possible definition of the image upon the screen.

(Courtesy Bell & Howell)
The Minusa screen opened for use.

In addition to this we must have a mechanism quite similar to that employed in the camera, whereby the film is supplied to the aperture and removed therefrom and restored to a compact roll. At the aperture the film must be held motionless while the actual projection is taking place and moved forward one frame while the shutter obstructs the light. As in the camera this is known as the intermittent movement, and is often quite similar to the camera movement in construction and operation, while some projectors make use of the intermittent sprocket movement known as the "star cam" or "Geneva movement," the movement used in most professional projectors.

The light is provided by an incandescent bulb made especially for projection. This has a concentrated filament suspended in one plane. This gives us a high candlepower of light *upon the film* compared with the heat generated. In front of this bulb there is a condensing lens. This lens bends the rays of light so that all of the light falling upon a circle of some 1½ inches in diameter is concentrated upon the film aperture which is only about 5/16 by 3/8 inch. This light beam serves to illuminate the film in the aperture. From this point on the efficiency of the projection depends upon the projecting lens.

Projection is the reverse of taking. In taking the lens passes the light emanating from the subject, to the film. In projection the lens passes the light from the film to the screen. The projection lens takes the place of the black cardboard shield with the small hole in it which we considered in the shadow analogy. It makes possible the use of a large light opening with sharp definition. It follows then, that just as in the case of the camera lens, the larger the relative aperture or "f" value of the protection lens, the brighter will be the picture with any given illumination.

In most projectors the illumination is increased by a mirror of parabolic form set just behind the lamp. This directs into the condensing lens those rays which are cast backward from the lamp. Thus in order, we have as a projection system: mirror, lamp, condensing lens, film, projecting lens, shutter and screen. The shutter may, and

often does, operate between the film and the projection lens or between the condensing lens and the film.

As these individual parts of the system must all be in good condition to give good projection, the failure of any one will injure the projection quality. For that reason we shall take them up one at a time.

Mirror: A true parabolic mirror has a definite focal point, just as a lens has. If we permit parallel rays to enter a corrected lens, those rays will be converged to meet at a common point. If we place an illuminant at the focal point of a parabolic mirror, that light will be reflected as a parallel beam of light. However, many projector mirrors are only spherical and suffer from all of the faults of spherical aberration, that is much of the reflected light is lost, no matter where the lamp is set with regard to the mirror. If a parabolic mirror is used, the illumination depends to a great extent upon the proper inter-relation of mirror, lamp and condensor. Try moving the mirror, if it is adjustable, while projecting a beam of light upon the screen. Naturally no film is used in these adjustments. Fix the mirror in the position which gives the most light. This adjustment is never made until the condensor is properly adjusted.

A mirror which is coated, tarnished, or one from which the silver is peeling will not give good results. Keep the mirror protected from scratches and friction at the back, and keep the surface polished with a soft cloth. A harsh cloth will scratch the surface of the mirror and in time injure its reflecting power due to the innumerable fine scratches dispersing the rays passing through the glass.

Lamp: The lamp will seldom give trouble until it is worn out. If an air leak is present the inside of the bulb will turn gray.

The lamp must be placed in proper position with regard to the projector, but as this position depends upon the condensor position it will be discussed under condensors.

Condensor: This is a lens or combination of lenses used to condense the light upon the film. It may be a special Fresnal type of lens, two plano-convex lenses or two plano-convex and one double convex lens placed in

proper relation. The two plano-convex lenses form the most common condensor system.

The condensor system has a focal point and it is important that the condensor be properly focussed. This is easily done by projecting a beam of light upon the screen without any film being in the projector.

The screen will either be intensely illuminated or it will have purplish blue shadows upon its surface. The position of these shadows indicate the error in relationship between condensor and lamp. If the shadow is annular or circular it indicates that the lamp is too near the condensor or too far from it. Move the lamp backward and forward until the shadows disappear.

If the shadows are semi-annular, the lamp is displaced, laterally or vertically. If the shadows are at the side of the screen the lamp is displaced laterally, if they are at top or bottom the lamp is displaced vertically and if they are near the corners of the screen, the lamp is displaced obliquely. The remedy is to move the lamp in the direction indicated.

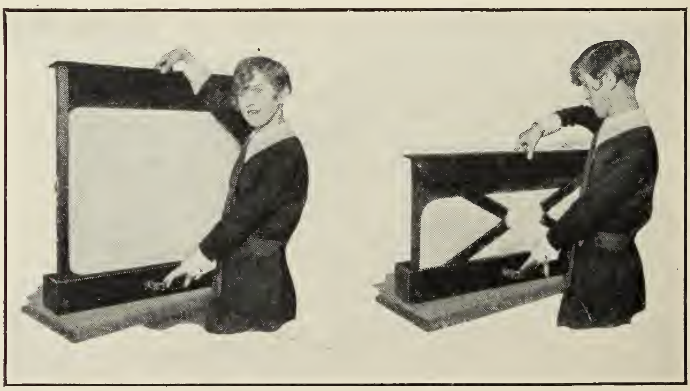
The condensor is almost certain to collect a thin film of oil from the mechanism and this in turn collects dust and dirt. Soon the surfaces of the lenses become so clouded that they lose much of their efficiency, perhaps forty or fifty percent. This in turn cuts down the screen illumination enormously. It is quite essential therefore that the condensor lenses be kept clean, and that they be polished periodically.

FILM: The subject of the care of the film is too broad to be covered here and will be discussed later in the chapter. In actual projection the film may be displaced in the aperture showing the frame line and parts of two pictures. This is remedied by moving the "framing lever" with which every projector is equipped. Moreover, the film often breaks during projection. When this occurs, the broken end is tucked under the corresponding broken end which is wound upon the take-up reel, and projection continued. The repair will be taken care of later.

PROJECTION LENS: The projection lens must be moved back and forth until the image of the film is shown plainly

upon the screen. This is known as "focussing." At times the picture will be dim and dull despite a perfect light system. In this case examine the projecting lens to see that it too is clean. The projection lens will not gather dirt as rapidly as does the condensor, but it will also accumulate a gray film of dust which must be removed if the original brilliancy of projection is to be maintained.

SHUTTER: The shutter obstructs the light while the film is in motion. As long as it does this it is satisfactory, but at times the shutter will become loosened upon the shaft and slip. When this occurs we have the film moving to a greater or lesser degree while the shutter is open. This gives rise to the "rain" effect upon the screen where the image is blurred vertically, making the scene look as though it were obscured by a heavy rainfall. This is corrected by restoring the shutter to its proper position. This is determined by operating the projector very slowly, turning the mechanism by hand. Note the position of the shutter when the film starts to move and the shutter position when the film travel stops. This will immediately show if the shutter is out of position.



The DeVry automatic screen. A sharp pull upon the cover of the case causes the screen to spring up into place, while a reverse motion closes it.

SCREEN: Many amateurs purchase the best camera and projector obtainable and then project their pictures upon a sheet, or white wall or any other old thing which they think will serve as a screen. This is a grave mistake. The

screen is one of the most important adjuncts used in motion picture projection. It has three attributes of importance in projection, i.e., size, color and surface texture.

The screen size is determined by the effective illumination of the projector. As the size of the screen or rather the size of the projected image is increased, the brilliancy of the picture diminishes. This is easily explained. We have a definite quantity of light falling upon the film and passing through the projector lens. If this light is spread over one square foot of screen surface we have a definite illumination, if it is spread over two square feet (not two feet square) of surface we have one-half that illumination and so forth. Remember that a screen two feet long requires four times the light that a screen one foot long does.

The effective brilliancy of the projected picture varies inversely as the square of the distance between projector and screen.

The color of the screen is quite important, but this is not a definite factor either. The color of the screen is determined by the effect desired, the average tone of the films projected and the nature of the light source. However, as these factors are fairly constant, the usual amateur screen is silver or aluminum bronze.

> This gives rise to a theoretical question. The bronze has practically no local color when illuminated by the projector light. It merely reflects the light which falls upon it. Due to the matte surface formed by the fine grains of the bronze, the light is diffused, that is it is reflected in many directions, the included angle of reflected light depending upon the granularity of the screen surface. It would seem that this would be an ideal screen and it is very good. It has, however some inherent faults. The tone of the color is cold and harsh. It is in fact metallic. The reflected light is of the same character as that of any light reflected from a matte surfaced metal. In addition to this, any waves or wrinkles appear as dark streaks across the screen. This is due to the character of the reflection.

The gold screen is used at times. This has the same characteristics as the silver screen with the exception that

the yellow tone of the gold bronze gives a warm tone to the picture, but at the same time the contrast of the picture is degraded. For this reason the gold screen is only advisable for use with very brilliant, snappy positives. With these it gives a projected image which is very attractive.

Another surface which has found great favor is the white screen. This screen is coated with a smooth coating, creamy white in color, with no suggestion of a cold or bluish white. This creamy color, like the gold screen gives a more pleasing tone to the highlights of the picture, but it does not degrade contrast. It is said that the white screen does not give as great a percentage of reflection as is secured with the silver screen, and this is probably true, for a white surface does not reflect as great an amount of light as does a silver one. However, the difference is not great. On the other hand, the white screen gives the pleasing tone mentioned and in case of slight waves or wrinkles it does not give the heavy shadows seen with the silver screen. The choice then depends upon individual taste. With a slight loss of illumination (but no degradation of contrast) the more uniform and pleasing projection is secured with the white screen, but for the greatest possible illumination the silver screen is used.

However, for good results the white screen must be one prepared for this express purpose. The white fabric "curtain" such as a sheet or similar cloth has a very low reflective power, nor is the plastered wall very good. The white coated screens have surfaces expressly prepared to give the highest possible reflection factor for the color used.

Recently another screen has been introduced. This is the bead screen. This is a screen whose surface is coated with tiny glass beads. This gives a projection quality which is liked by many amateurs. The quality of reflection is similar to that given by the silver, but as in this case the beads are white glass, we do not have the metallic lustre of the highlights, and get a result which approximates the white screen quality. The bead screen is really a half-way screen between the white and silver, but with peculiar qualities of its own.

These screens have all been developed to such a point that any one of them, of any type, will give the utmost satisfaction, for after all, anything must have merit if it continues to exist.

A second point to be considered concerning screens is the support and protection of the screen. In many instances the support and the protection have been combined in a carrying case. The case is opened, the screen raised up and folding uprights support the screen in this position. This type of screen is made by most manufacturers. Perhaps the DeVry screen is the most highly developed of this type of screen. The case is laid upon a table or other support and the lid lifted by grasping it through the two holes in the lid. As soon as the lid is lifted a spring action raises the screen into place and holds it there. The screen mounting is such that an even tension is maintained, preventing a sagging or wrinkled screen. These screens are made in various sizes in both silver and bead surfaces.

The ACH screen support is one of the most highly finished supports made. A rigid, well-made tripod stand is supplied which supports the ACH white surface screen in any desired position. Due to the fact that no table or wall hanging is required the screen is instantly placed in any desired part of the room without disturbing any furniture. This is a point of great importance, as many housewifes object to having the furniture moved about to make ready for a motion picture exhibition.

In this connection the ACH projector stand may also be mentioned. This stand is similar to the screen support, having the same type of base, but the top of the column supports a projector clamp of such perfect design that it will hold the base of any available sixteen millimeter projector and hold it so rigidly that the projector cannot be knocked off the stand. This stand also has a support for a ten-reel humidor box. This box provides storage for the film, but when attached to the projector stand it also forms a convenient table for the operator, so with the ACH equipment the operator has all necessary facilities for giving a

perfect exhibition, yet there are no makeshifts, no furniture wrestling. One small case contains the whole outfit which is set up in a few moments, and as quickly packed when the evening's entertainment is over.

Before purchasing a screen it is necessary to determine the focal length of the lens to be used with the projector. This is a subject which proves confusing to most people. The projection lens must be placed a definite distance in front of the film. This distance is determined by the focal length of the lens used. A short focus lens is placed nearer the film than would be one of long focus. It follows then that the shorter focal length lens, being placed closer to the film will emit a wider angle of light than would a lens farther from the film.

The shorter the focal length of the lens the larger will be the size of the projected image, all other things being the same.

It also follows that, inasmuch as the light is projected from the lens in the form of a cone, the farther the screen is from the projector, the larger will be the image. The question is, "How can the proper focal length be determined."

In all sixteen millimeter projection we have one fixed factor, the size of the individual frame. The screen size, throw (or distance between projector and screen) and focal length of the lens used are all variable. The screen size is determined by the preference of the owner, and by the intensity of the light used. The throw is largely determined by the size of the room in which the projection takes place and the focal length of the lens is determined in turn by these two factors. For example suppose that we have a distance of ten feet between projector and screen and we want to secure a picture about three by four feet, or slightly less for projection upon a screen of that size. By referring to the table in the Appendix we see that a lens of one inch focus will give us a picture 2.85 feet by 3.85 feet giving us something near a one inch margin all around the image when projected upon the three by four foot screen.

As the 30 x 40 inch screen has become almost the

standard size for amateur projection, the focal length of the lens will ordinarily be determined by the throw alone. (For table of projection sizes see Appendix.)

With the proper lens selected the projector is ready for use. It should be unpacked, set up, adjusted and threaded in exact accord with the directions supplied with the instrument by the manufacturer.

After the projector is running there is no apparent limit to the troubles which may occur, but fortunately these troubles very rarely do occur. The modern amateur projector is so well designed and so well built that it is as nearly trouble-proof as a mechanism can be made, but it is well to understand the possible faults so that if they do occur they can be easily and quickly remedied. If something should happen while you were projecting a film for friends—and such troubles never occur except when guests are present—it would embarrass you greatly if you could not remedy it, but if you could pass it over with a light remark and have things running again almost immediately, the situation would be saved.

Therefore, we shall consider a few of these troubles which may occur but which seldom do.

Screen Goes White:

There is but one cause for this occurrence, there is no longer any film in the gate. This may be due to the end of the film running through the gate or it may indicate a broken film. If the film is broken, rethread the projector as usual, tucking the broken end under its complementary end upon the take-up reel and proceed with projection.

Screen Goes Black:

If motor is running and shutter is turning—Lamp burned out, replace with new one.

If motor stops at same time; Electrical connection broken, trace current supply for location of break. This requires the service of an electrician if you are not familiar with electrical repair work.

If lamp burns and motor runs: Shutter probably stopped due to broken part or shutter becoming loose upon the shaft.

Picture Becomes Stationary:

Motor stops. Current supply to motor is too weak or motor connection is broken.

Motor runs. Suspect torn perforations. Open gate and examine film. Move film down until fresh perforation is engaged. Single frame clutch thrown out.

"Rain" Effect:

In this case the picture looks like it was being viewed through a heavy rainstorm. The effect is produced by the film being pulled down before the shutter closes. The fault lies in a loose or slipped shutter. Loosen shutter on shaft, then turn until the intermittent just starts to pull film down. Place shutter so that its front edge covers the aperture and fasten in place. Now rotate the mechanism slowly and see if the film stops dead still before the shutter uncovers the aperture. This will remedy the fault.

Perforations Appear upon Screen:

This is followed by a film stop. It indicates that the film has jumped from the gate or sprocket and this usually means a torn film also. Stop machine, remove damaged film from gate, rethread and proceed with projection.

Film Chatters in Gate:

This is usually accompanied by a dancing of the image upon the screen, by a loss of focus and general poor projection.

The cause is an accumulation of gum from the film. This is a mixture of softened gelatin from the emulsion, hardened lubricant and dust. It is about of the consistency of cold shoemaker's wax or harder. This mass becomes tacky when slightly warmed by the heat of the lamp and friction. This drags upon the film surface just as rosin will cause the finger to drag and "chatter" when a rosined fingertip is rubbed upon glass. The mass is removed by a horn or hard rubber scraper. *Never use metal* for this purpose. Metal will scratch the gate, and these scratches will act as tiny chisels which in turn scrape more gum from the film thus aggravating the trouble.

If the mass does not come away easily, moisten it. This makes removal much easier.

PICTURE DULL AND DIM AS COMPARED WITH OTHER PROJECTIONS:.

Dirty lenses.

Condensor, lamp and mirror have lost their alignment. Readjust.

Line voltage low, advance rheostat control of lamp.

LOSS OF LOOP:

This is due primarily to careless threading. It is announced by a humming ripping sound ending with a snap as the film breaks. Rethread *carefully* and proceed with projection.

This loss of loop is a problem which gives a great deal of difficulty to the owners of certain types of projectors, but it need not occur if the threading is carefully done. When the film is placed around the sprocket, there is nothing to hold it in place until the guard rollers are locked in place. In those cases where all guards snap into place with a single movement, watch carefully to see that the teeth of the sprocket engage the perforations of the film upon both sides of the sprocket or upon both sprockets, if a double sprocket machine is used.

BULBS BURN OUT TOO QUICKLY:

You are using too much current. Adjust the rheostat to give a slightly less brilliant light. In cases where the current pressure is unusually high it may be necessary to insert a resistor of low value in the line. Resistors are available which will give roughly a 5 volt drop in pressure. For greater drops these resistors are connected in series.

ALTERNATE SHARP AND SOFT DEFINITION:

If the gate pressure pad springs are too weak, the heat of the lamp may buckle the film causing it to push the pressure pad backward, thus throwing the film out of the focal plane. Have new springs inserted.

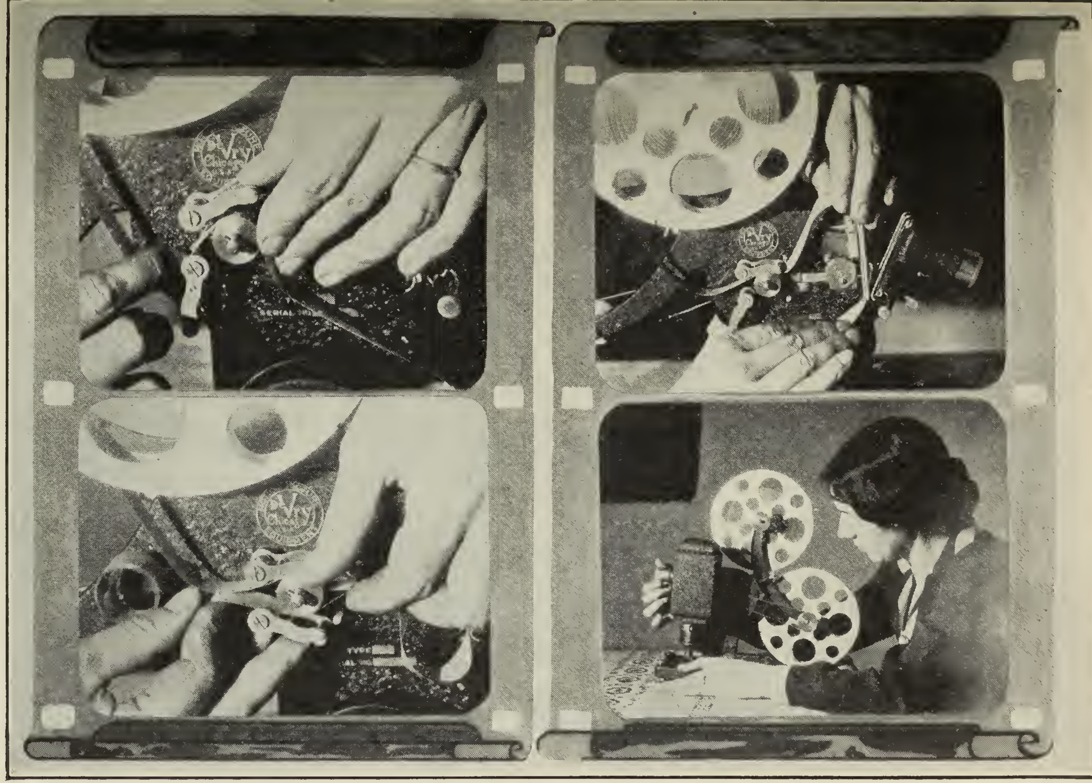
These points cover most of the faults encountered in projection, that is, the faults due to the mechanism itself. If a faulty film is placed in the projector, the machine cannot be blamed for poor projection. Because of this fact, the film should be carefully examined before it is projected, and periodically, all films in active use should be examined or "inspected," as will be explained later.

The selected film is removed from the humidor, the film clip removed and the reel placed upon the projector. Have all reels marked, stating whether the film is an original reversed film or a printed positive or reversal duplicate. The reversed films (originals) are threaded through the projector with the individual images upside down and the polished side of the film toward the light. The printed positives and reversal duplicates are threaded upside down but with the dull side of the film toward the light. The light referred to is the projector light. The opposite side of the film will then be facing the projection lens.

In most cases this means that the side of the film which faces the lens will be wound upon the outside of the reel. This point should receive careful attention as otherwise the pictures will be reversed from right to left.

This reel is placed upon the projector and about eighteen inches of the "leader" pulled from the reel. This is threaded according to the manufacturer's directions. When the last sprocket or the lower side of the master sprocket is threaded, there should be a sufficient length of the leader left to be attached to the take-up reel. This is done by slipping the end of the film into the slot cut in the hub of the reel. This is at best an awkward job, and often consumes as much time as the rest of the threading together. This tedious operation is rendered unnecessary by using the ACH self threading reel. In place of a slot in the reel hub, there is a small plate of spring steel. This plate bears two prongs upon each end. The film is dropped between the film flanges and pressed against the hub with a finger thrust through one of the openings in the reel flange. The reel is then turned around. The prongs catch the perforations and carry the end of the film around the hub. As the plate is double ended, the film will be caught regardless of the direction of revolution of the reel. It may be remarked that these reels are notched at the factory for use with the ACH film clips.

When the projector is threaded, glance at the film to see that both sprocket engagements are properly made and that the loops are of the right size. If everything is properly set, start the projector. If all of the preliminary



THREADING THE PROJECTOR

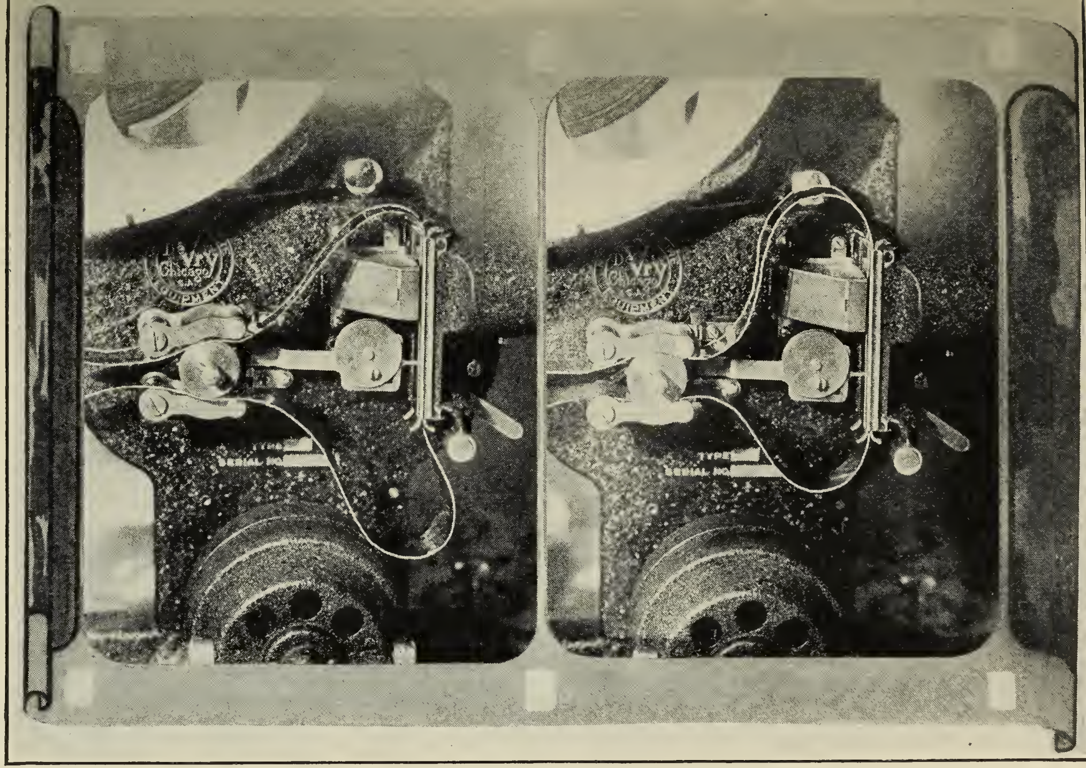
1. Place film over upper surface of the sprocket, see that teeth enter perforations then close guard rollers.
2. Place film in gate, fitting it properly into the film channel and leaving a proper loop above the gate.
3. Leaving the proper loop below the gate, pass film over lower surface of sprocket observing same precautions as in the first step.
4. The projector in use with the left hand upon the control switch and near the stop picture control.

steps have been properly taken, the picture should now be projected upon the screen properly spaced and properly focussed.

This is the point where the difference between the carefully prepared film and the haphazard film will show. The first shot may be a skating scene taken near sunset. This is placed in the projector, the lights dimmed and the projector started, but before we turn on the switch, we throw a blue screen in front of the projector lens and project a blue tinted film. Following this we have an autumn scene and a forest fire. We drop the yellow screen in front of the lens until the fire is first seen, then as the fire rises we change to the red screen. These little color screens which cost so little and which are so simple, are invaluable to the projectionist who takes pride in the screen quality of his pictures. He secures an effect to all intents the same as that secured in professional work by the use of tinted films. It may be added that sixteen millimeter film is now available in amber color and is soon to be supplied in all of the standard tints.

Many people, ardent "movie fans" think of natural colored films when tinted films are mentioned. This shows that the film tints, properly used are so natural that their presence is not noticed, but if they were to be removed from the film the spectator would notice the absence immediately, although quite possible he could not state definitely the cause of his dissatisfaction with the projection.

Every scene requires its own particular tint. In professional theatrical films, perhaps 95% are printed upon tinted film. This means that the celluloid upon which the sensitive emulsion is placed is actually colored. These colors are usually, yellow, light amber, amber, pink, blue, green, red and lavender. Of these the ones most often used are yellow, light amber and lavender. The lavender is not a purple or violet, but a rather cool, smoke or pearl gray with just a touch of bluish tone. This is used for night scenes, interior scenes, scenes in deep shadow and similar scenes which are intended to show a cool yet mellow shadow.



1. Note that the film is not correctly placed upon the sprocket, it rides over the edge, the guard rollers cannot close properly, the upper loop is too short endangering the film by dragging it across the upper end of the film gate and the lower loop is so large that the film drags against the motor housing.

2. The correctly threaded projector. The film fits the sprocket snugly, and the loops, while large enough to provide perfect action, are small enough to keep the film from touching any part of the machine except the gate itself.

The yellow stock is almost "standard." It is used when no other tint is specifically demanded. It gives a golden tinge to the highlights which resembles the quality of summer sunshine and makes the picture appear more brilliant yet with decreased contrasts. The effect is similar to that noted when looking through yellow spectacles at a landscape. When in doubt use yellow tinted stock.

Light amber is used in almost the same way but as it has a dusty russet tinge it is used for subjects which have a general tawny tone, such as dry grass plains and so forth. Deep amber is hard to use, in most cases, but for a late autumn shot it gives a rich autumnal brown which gives almost the effect of a natural color film. It is recommended for such scenes, also for "dusty dry" desert scenes and similar shots.

Blue is used for night, moonlight and snow scenes. The reason is immediately apparent. The character of these scenes in nature is such that much of the normal yellow tint of sunlight is absent or neutralized, and the absence of yellow results in a blue tint.

Pink is used for sunrise effects almost exclusively.

Green is used for marines and for deep woodland. Green is difficult to use as few subjects appear correctly when printed upon green stock. This is one tint which, like red, is immediately apparent when used in projection.

Red is used for explosions, fires, and all similar scenes.

There is just one thing to remember in using filters rather than tinted film. The tinted film has the color situated practically in the focal plane, and it therefore affects the definition to a very slight degree. However, the filters are placed in front of the lens where they will have some effect upon the lens definition. Therefore it is quite necessary that such filters be of very thin celluloid or of optically ground flat glass having either no appreciable, or a uniform index of refraction. If this point is neglected, there will be a distortion of the image upon the screen.

The most satisfactory way to secure projector tints is by the use of reliable tint filters such as the Filmo projector color filter, a manually operated set of filters or an automatic device such as the American Ciné Colorator.

The latter has the filters entirely enclosed in a dust proof casing, with an outside controlled automatic action. With such devices no apparent distortion is present due to the high quality of the glass used.

These devices have four individual filters, any one or any combination of which may be placed before the lens instantly. There are fifteen distinct tints which may be secured by using various combinations. In fact, it is possible to change a scene from an apparently brilliantly illuminated sun-bathed landscape to a very good night effect. By careful manipulation the changing light effects of dawn or nightfall can be imitated to a surprising degree.

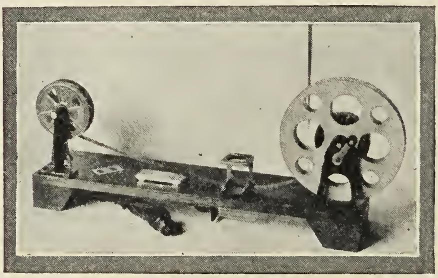
Do not keep up a running fire of commentary while the film is being projected. Your film should be so well titled that it needs no commentary whatever. In fact many amateurs make a practice of providing appropriate phonograph music for film accompaniment. The phonograph is used in preference to the radio because the music may be selected to suit the film which is being projected. This not only discourages irritating conversation, but if some judgment is shown in the record selection it adds materially to the quality of the projection.

Lighting Projection Room.—And now as to the illumination of the room during projection. An absolutely dark room is neither necessary nor desirable. The flashing of the white screen before and after a reel is shown is annoying if not positively painful. Of course expert projector operators never allow the screen to flash white, but this skill is not attained without considerable practice.

A bridge lamp is one of the most convenient sources of illumination for the projector. This should be fitted with a deep, opaque or almost opaque shade. The bulb should be deep orange or light red. This will give a considerable amount of illumination in the room, enough to allow those present to move about with perfect freedom, but it will not interfere with the projection to any apparent degree. This is far better than to have the room plunged into darkness and then start the projection.

When the switch is turned on the screen should show

the main title, correctly framed, and in perfect focus. Before the spectators are assembled, the machine is set in place, the lens focussed properly and so placed that the frame is properly centered upon the screen. The frame is set properly in the aperture, and as sixteen millimeter projectors are almost automatic in framing this should give no difficulty. In threading, pull out enough leader to place the main title in the gate before starting the machine. Then if a trailer bearing the word "Finis" and about three feet long is attached to the end of the film, the projector can be stopped before the screen flashes white.



(Courtesy Amateur Movie Makers)

The Twogood title inspection device which enables the editor to examine the film while it is being slowly rewound.

One of the principal objections to the home projection is that the act entails so much disturbance in the home. Tables are set up in the center of the room, one for the projector and one for the screen, or the screen is hung from the picture rail, and a table dragged up for the projector. In fact, while this seems an insignificant detail, it is one which causes a drop of at least 50% in the number of hours of actual amateur projection.

Projection in its easiest form is secured by the use of stands of the type known as the ACH stands, which have been described.

After the evening's projection is over, before the equipment is stored away, the films should all be rewound, if they have not been rewound before removing them from the projector. Care should be taken to see that they are properly wound, ready for rethreading for the next pro-

jection. Then all reels should be securely locked against accidental unwinding by the use of film clips.

Then they are stored away in their humidor cans or in the humidor case. If these precautions are taken after every evening of projection both films and projector will last almost indefinitely.

Every two or three weeks the films should be inspected. During this inspection torn perforation and scratches are searched out as has been explained. The film is wiped with a piece of soft cloth or it is pulled between two small blocks which have been covered with several layers of soft, lint-less cloth. This will remove dust and dirt. The pads should be changed frequently to prevent any metallic or other gritty particles from scratching the film during this cleaning.

For this work the cutting rewinds are called into play. The full reel is placed upon the dummy stand and the free end of the film attached to the empty reel upon the geared stand. The film is now slowly rewound, while the edges are allowed to run through the thumb and finger of the left hand. In this way any broken perforations will be felt. At the same time any large scratches or other faults will be seen by looking downward through the film at the cutting light. As long as the film is held between the thumb and finger there is little danger of running too fast for above a certain speed the film will burn and cut the fingers.

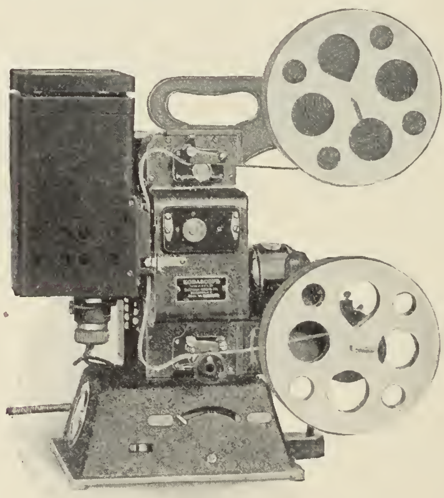
When a torn or broken perforation is found the procedure differs according to the type of projector being used. If this projector has a single claw operating upon one edge only of the film, the frame must be removed and a patch made in the film, but if a star-cam sprocket is used for the film drive, the torn perforation is neatly trimmed with a sharp blade or pair of scissors so that it will pass through the mechanism without catching in the gate.

For this film inspection the ACH film inspection outfit will be found to be very satisfactory. This outfit, consisting of rewinds, splicer and magnifier allows each frame to be closely examined as it passes from reel to reel. This is

a device which the careful editor will appreciate as well as the amateur projectionist.

At the same time notice the condition of the celluloid itself. If it feels too flexible, allow the reels to lie outside the humidor for a day or so and remove some of the moisture from the pad in the humidor box. If the film is hard and brittle, increase the moisture of the humidor pad. If the proper degree of humidity is maintained in the humidor, the life of the films will be greatly extended.

After having considered some of the general features of projection let us consider the leading sixteen millimeter projectors now offered upon the American market. This list is not intended as a complete catalog, but merely as a series of brief specification lists.



(Courtesy Eastman Kodak Co.)
Kodascope Model A.

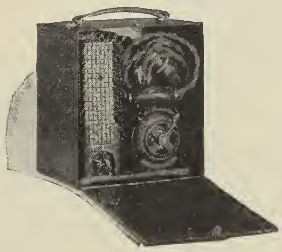
EASTMAN KODASCOPE MODEL A

This is a large machine, the largest sixteen millimeter projector on sale, but it is also among the best. It is made throughout with a quality which matches that of the original Ciné-Kodak. It is designed for intense illumination and it will satisfactorily project a film at a much greater degree of enlargement than is usual in the sixteen milli-

meter work. For those who want a strictly high class instrument, this Kodascope is recommended.

Specifications of the Kodascope:

SIZE—18½ x 15 x 10½ inches
WEIGHT—20 pounds
CAPACITY—400 lineal (1000 equivalent) feet of 16 millimeter film
LENS—Two-inch focus, finest quality
CURRENT—110 volt house current
LAMP—Either 14 volt, 56 watt or 50 volt 200 watt. Control by means of special rheostat and ammeter which are integral
FOCUS—By conveniently placed knob
FRAMING—By adjusting screw
REWIND—Manual



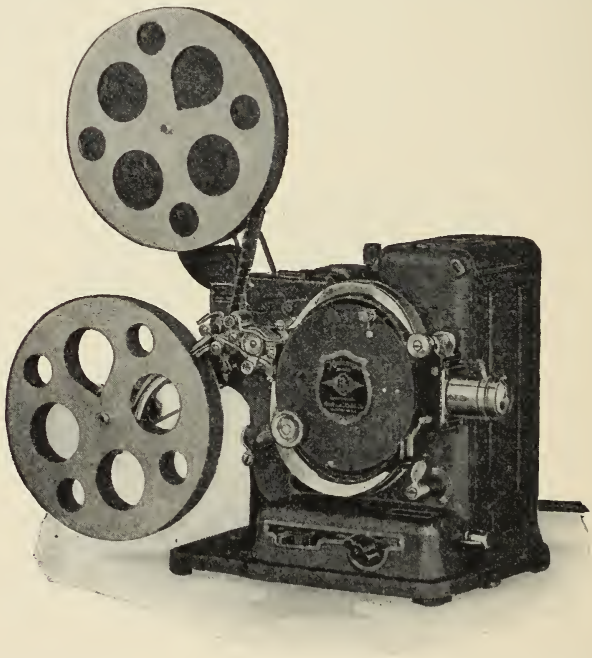
(Courtesy Eastman Kodak Co.)
The Kodascope Model C may be packed in a small, compact case for transport or storage.

The next Kodascope to be introduced was the model "C" which is essentially a projector for home use. This is a small, compact projector well liked by many amateurs due to its small bulk when packed and its light weight.

Specifications of the Kodascope Model "C":

SIZE—5½ x 7 x 8
WEIGHT—9 pounds
FOCUS—Spiral lens mount
FRAMING—Lever actuated
STOP FILM—Lever actuated for still pictures
CAPACITY—400 lineal or 1000 equivalent feet of 16 millimeter film
LAMP—115 volt, 100 watt special
CURRENT—110 volt house current
REWIND—Manual

Just recently the Kodascope Model "B" has been introduced. This is a strictly modern amateur motion picture projector, which has been brought strictly up-to-date. It incorporates many new features which reflect the demand of the modern amateur. The time has passed when the amateur will be satisfied with a miniature take-off of a professional projector. The amateur refuses to accept this idea in camera construction and this new projector shows as many radical changes as did the amateur camera.



The Kodascope Model B. This is the latest and finest of the Kodascopes. It is so designed that the film need only be started in the first sprocket and the machine will automatically thread itself, forming the proper loops.

The instrument folds compactly for packing or transport, yet when in operation it presents a very attractive appearance which will grace any living room. All bulky parts have been consolidated in a regularly shaped area at the left side of the machine. By using a reflecting optical system the lamp house and shutter have been placed at one side instead of at the rear of the instrument, which

idea is applied to another recently introduced projector, the DeVry, and which appears to be growing in favor. This arrangement certainly adds greatly to the general appearance of the instrument in addition to its more technical advantages.

The controls are well designed. An ammeter enables the operator to operate the instrument at its most efficient current drain, regardless of current fluctuations. The start-stop-rewind-still picture control is remarkably convenient. The use of the still picture device automatically places a safety shutter between the illuminant and the film, preventing film blisters from the high intensity light.

One of the features which will appeal to the modern amateur is the self-threading feature. This feature abolishes one of the most vexing features of amateur projection. It is hardly practical for the average amateur to use two projectors, so that the screen is necessarily dark between reels. In hurrying the threading, to cut this time down, the operator often fails to thread properly with the result that a film jam or break occurs which in turn does much to take away the pleasure of projection. In this machine the end of the film is cut square. It is then started at the upper sprocket face. The machine then proceeds to thread itself, completing the operation and starting the film upon the take-up reel.

These features together with the specifications noted below indicate that this is a projector which will enjoy wide favor.

Specifications of the Kodascope model "B":

SIZE—(folded) 10¼ x 7½ x 9¼ inches
WEIGHT—13¾ pounds
FOCUS—Spiral focussing mount with lever knob control
FRAMING—By framing screw at side above lens
THREADING—Manual or automatic at will
STOP-FILM—By lever on side of instrument
CAPACITY—400 lineal or 1000 equivalent feet of 16 millimeter film
LAMP—50 volt, 200 watt Kodascope special
CURRENT—110 volt house current
REWIND—Motor driven

MOTOR—Integral, 110 volt universal, forward, stop or reverse by switch

These three Kodascopes offer a choice from which practically any amateur can select a suitable projector, and all are of Eastman quality.

THE VICTOR PROJECTOR

One of the first amateur outfits brought out was the Victor. The projector is virtually the same as it was originally, except for the improvements which may be expected in any machine. The original basic design is used—and has been imitated to a certain extent by other manufacturers, indicating its excellence. This projector is one of the few which makes use of the side-by-side film reels. It has been used, in various models, for almost five years now, and has given entire satisfaction.

Specifications of the Victor Ciné Projector:

SIZE—6 x 10 x 14 inches in case

CAPACITY—400 lineal, 1000 equivalent feet 16 millimeter film

OPTICAL SYSTEM—3 lens condensor, 2 lens projector, with mirror reflector

MOVEMENT—Victor patent unilateral claw drive

DRIVE—110 volt, universal motor with speed control on base of machine

LAMP—50 C.P., 14 volt, double contact, automobile type Easily replaceable. Variable resistance built in case.

SWITCH—One, for lamp, and motor

REWIND—Manual

SHUTTER—High aperture, flickerless

TAKE-UP—Enclosed spring belt

THE FILMO PROJECTOR

The Filmo projector is a suitable companion to the Filmo camera. It has been widely adopted for commercial use due to its high efficiency and compact size. The specifications tell the story of a very fine amateur projector.

SIZE—Packed in case 8 x 11 x 11 inches

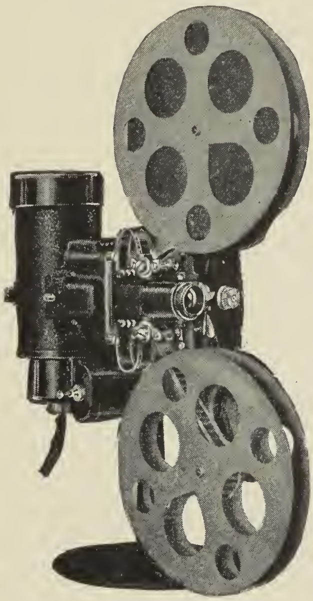
WEIGHT—Alone, 9 pounds. Complete with case, spare reels etc. 14½ pounds

CAPACITY—400 lineal, 1000 equivalent feet 16 millimeter film

OPTICAL EQUIPMENT—Mirror reflector, plano-convex condensors and finely ground projector. The projection lens is mounted in a micrometer focussing mount and may be secured in any focal length from one to four inches. All are interchangeable in the standard mount

MOVEMENT—Shuttle, 9 to 1

SHUTTER—216 degree opening



The Bell & Howell Filmo Projector

MOTOR—110 volt, universal, integral part of machine

CONTROL—One for both lamp and motor

COOLING—Forced air draft cools entire mechanism and allows single frame film projection without film warp

LAMP—50 volt, 200 watt Filmo special

RHEOSTAT—Integral, positive cooling

SPEED CONTROL—Knob

REVERSE—Instant by turning switch

STOP-FILM—Film may be stopped at any point

REWIND—Geared

In addition the following accessories are offered for use with this projector:

SPLICER—Press, knife, water and cement bottles

REWIND—Usual type adapted to small size

EDITING OUTFIT—Rewind and splicer on one base

LENSES—1 in., 1½ in., 2 in., 2½ in., 3 in., 3½ in., and 4 in.

CASE WITH SCREEN—Case with special daylight screen may be secured to order

COLOR FILTERS—For showing films in various colors

SPECIAL CONDENSER—Increases light from 50% to 75% but prohibits stop film

SPECIAL RHEOSTAT—For compensating current changes where steady, uniform current is not available. Also for 32 volt and for 220-240 volt lines.

THE DE VRY PROJECTOR

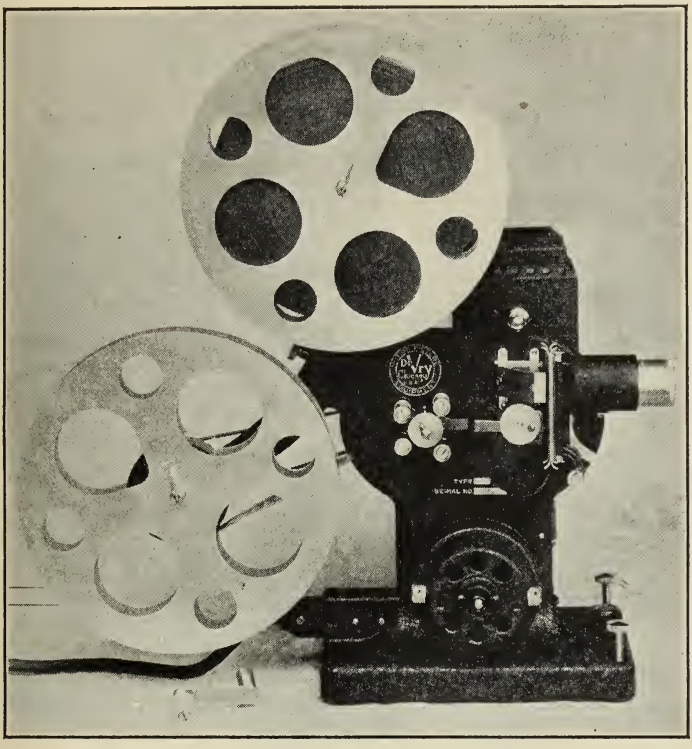
The latest introduction in the field of the substandard projection machines is the DeVry sixteen millimeter projector. For years DeVry has produced the world's standard portable suitcase type projector, and the new sixteen millimeter model promises to rival its big brothers in quality of workmanship and operation. This projector is quite different in appearance from others, but there is one feature which is instantly apparent to the most casual observer. That is its unusual simplicity, which is one of the most valuable features of this machine. Any mechanic knows that in any machine, every added part, means added possibility of trouble.

While the base and supporting column are not at all heavy in appearance, the controlling rheostat, the single-picture clutch and the elevating feet are all contained inside this casting. This gives the projector a very "clean" and trim outward appearance.

The lamp-house is swung at the left-hand side of the instrument, the bottom supported by a split yoke and the top secured with a nickeled thumbscrew. To remove the lamp-house for cleaning the lenses or to give access to the mechanism, the thumbscrew is loosened, and the lamp-house lifted off the rest of the mechanism.

The shutter is concealed in the central pillar, revolving

between the condensor and the prism which bends the light beam at right angles. This makes a more convenient and more easily handled projector than the type in which the illuminant and the projection lens are laid out in a straight line.



The DeVry 16 m/m projector. This is one of the latest projectors to be introduced. It is small and compact, yet it has a very powerful light source making projection possible even in rooms lighted with usual daylight. It is simple to operate, easily threaded and gives perfect projection.

Specifications of the DeVry 16 millimeter Projector:

SIZE—Projector alone 6¾ x 7 x 9½ inches. With reels attached ready for·operating, 7 x 12½ x 14 inches

WEIGHT—7 pounds

FOCUS—Spiral lens mount with knurled focussing ring

CAPACITY—400 lineal, 1000 equivalent feet 16 millimeter film

OPTICS—Mirror, condensor, prism and superior quality projection lens. Lenses of various focal lengths are interchangeable in standard mount. f 2, 50 millimeter provided with projector

MOVEMENT—Improved unilateral claw, positive action

STOP FILM—Film may be stopped at any point. Fire shutter drops into place automatically

SPEED—Variable

CONTROL—One for lamp and motor. One for single frame. Both on left side of machine

MOTOR—Universal, 110 volt

REWIND—Automatic or manual by geared rewind

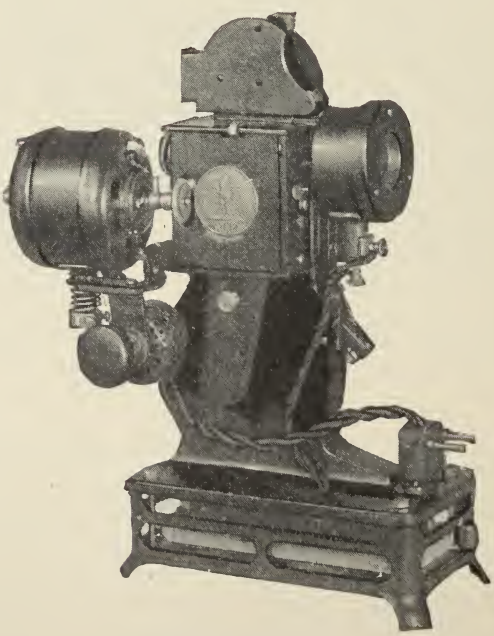
HAND CRANK—Provided for use when desired

IDLERS—Lock in place

LAMP—100 or 200 watt optional

FRAMING—By lever

The efficiency of this projector is shown by the fact that easily viewed pictures may be projected in ordinary daylight using the ordinary opaque screen. The intensity of



The Pathex Projector

illumination is not exceeded by any sixteen millimeter projector in use to-day.

This completes the list of the sixteen millimeter projectors. However there is the Pathex projector, the "Little Giant" which makes use of the 9½ millimeter Pathex film. This projector is the smallest practical motion picture projector manufactured.

The operation is semi-automatic. There are no sprockets, the double, central claw and the take-up providing the whole film movement. With this projector all motionless scenes, such as views, titles and so forth, are printed on only one or two frames of film, the projector stopping automatically for such frames. These projectors are made for more or less continuous projection, and in the small model, the film changes may be made in ten seconds or less time. The larger model which is equipped with 400 foot reels is handled more nearly like the usual sixteen millimeter projector.

The projector has a positive rewind. That is to say, the rewind is a highly geared, built-in device, and the film must be rewound before it can be removed from the projector.

The small projector has a capacity of 60 lineal or 150 equivalent feet of film. This film is kept wound in small metal magazines which protect the film from any kind of injury.

Specifications of the Pathex Projector:

SIZE—4 x 7 x 13

CAPACITY—(a) 60 lineal, 150 equivalent feet (b) 400 lineal, 1000 equivalent feet

OPTICAL SYSTEM—Mirror reflector, plano convex double condensor and finest high aperture projection lens in focussing mount

SHUTTER—Cast integral with balance wheel

MOTOR—110 volt, universal with compression rheostat control

CONTROL—Light and speed by separate rheostats

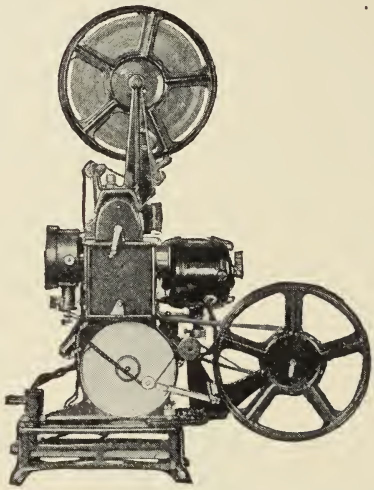
LAMP—New, special high intensity Mazda

CURRENT—105-115 volt house current

REELS—Special magazine type

FILM—9½ millimeter gauge

TAKE-UP—Slip belt drive, automatic pick-up
STOP-FILM—Automatic or manual. Automatic at any predetermined point
REWIND—Geared integral
MOVEMENT—Double claw engaging two central perforations at one time
DRIVE—Electric motor or manual at will



(*Courtesy Pathex Inc.*)
The Pathex Superreel which enables the owner of any standard Pathex projector to adapt it for use with 400 foot reels obviating the frequent changing of films.

These two gauges promise to become the standard sizes for amateur motion pictures. While the sixteen millimeter film is firmly established in America, the 9½ is favored in many other countries.

Other gauges may be ignored, at least for the present. Europe is bringing out a great number of novelties, some of which continue to be used while others flare up and die. Our own production is more or less uniform, due to our standardized methods of manufacture, leaving the production of novelties to our overseas cousins. Among these is a vest pocket projector for the 9½ millimeter film. This projector is about the size of the Pathex-camera.

There are several projectors now completed and in operation which may be announced soon. The writer

has had the pleasure of seeing one entirely automatic projector, which gave a screen size of about 7 x 9 feet with all of the quality of theatrical projection, yet the film was sixteen millimeter. Another promised novelty is a combined camera and projector, with a 170 degree taking shutter and a regulation three sector projector shutter. Several new smaller accessories are also promised, including a "watch" movie camera and amateur films in natural color. The country is now teeming with motion picture invention and no doubt the next five years will see revolutionary advances in the art.

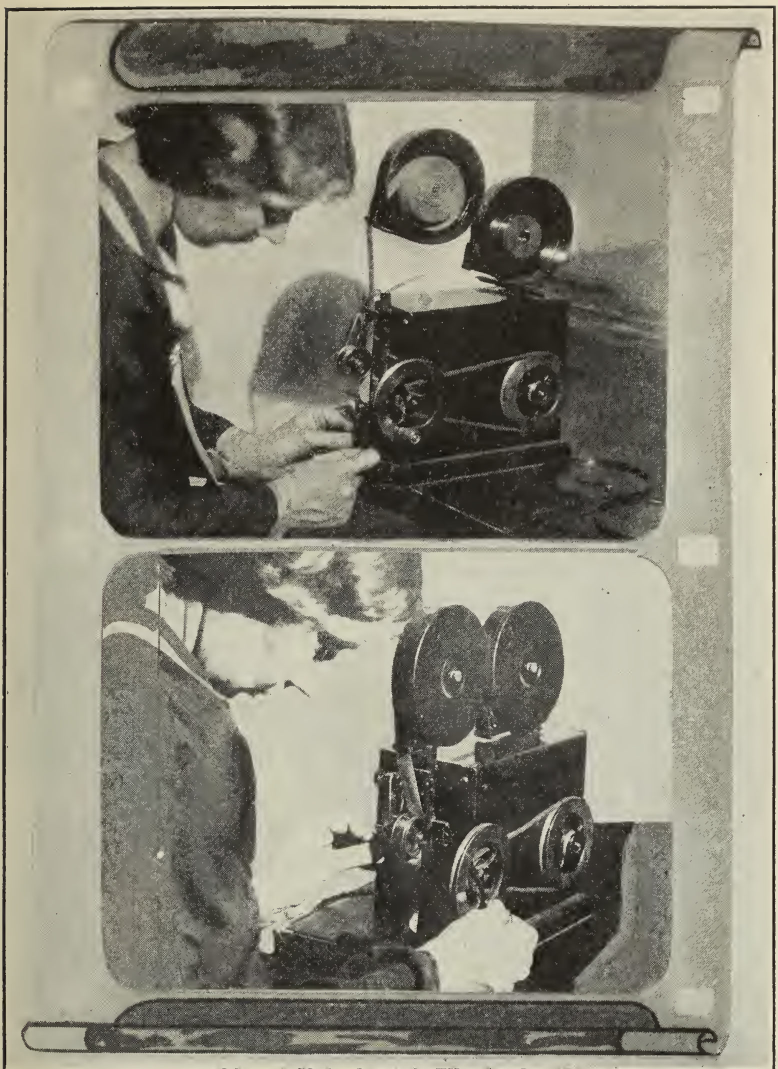
CHAPTER ELEVEN

WHICH BEING FOR THE EXPERIMENTER MAY BE PROFITABLY NEGLECTED BY THOSE AMATEURS WHOSE INTEREST LIES IN PRODUCING BEAUTIFUL FILMS, RATHER THAN IN THE MODUS OPERANDI OF THIS PRODUCTION

The modern motion picture enthusiast belongs to one of two classes. He either makes films to have them on hand for projection, or he makes them for the love of the work. The first type of worker will find but little of interest in this chapter. His is a worthy and commendable interest, but this chapter we shall devote to the others, those who love the work itself, and who, very often, have little if any interest in the completed film.

Motion picture films are made just as the ordinary films are made. The light passing through a lens impresses the film, the greater the intensity of the light the greater the impression made. In any case, white objects will be represented by a heavy deposit of metallic silver in the gelatin of the emulsion, and will form the blackest portion of this film. This is the negative. From this the positive is made which is the exact antithesis of the negative, white becoming black and black becoming white. This final print, the positive, is the one used in the projector.

Positive Processes.—This positive is made by one of two processes. If the positive is printed upon the same film, and in the same emulsion which forms the negative, we call the process "reversal," if, on the other hand, the negative film is dried and preserved and positive prints made from this master negative, but upon separate and distinct pieces of film, then we call it the "two film" "printing," or "negative-positive" process. Both systems have advantages and both have enthusiastic adherents. As to the actual superiority of one process over the other, time alone will determine that. For the present, we take



PRINTING 16 M/M FILM
1. Loading the Stinemann 16 m/m printer
2. Printing the film with the Stinemann printer.

pleasure in presenting the views of the two greatest proponents of these respective processes. The first process to be used was the reversal process, and its advantages are presented through the courtesy of the Eastman Kodak Company. Recently, a negative-positive process for sixteen millimeter films has been perfected and its advantages are given here through the courtesy of the DuPont-Pathe Film Manufacturing Corporation. We make no editorial comment, allowing each of these articles to speak for itself.

However, before going ahead with these argumentative articles, let us briefly glance over the basic photographic process.

We know that the lens forms an image, and that this image falls upon the sensitive material or the "film." Just what is the film, and what is its reaction to light?

The film has as a base a thin ribbon of flexible celluloid. This celluloid is merely a vehicle and has nothing to do with the photographic reaction. The true sensitive material is of complex nature and very difficult to prepare. It has two major constituents. First we have the gelatin, which provides the support, and second the photo-sensitive silver-bromide. Thus we have the celluloid which preserves the physical form of the film, the gelatin which serves as an adhesive "body" and the silver-bromide which is the actual sensitive material.

Chemical Effect of Light.—When light falls, even for a minute fraction of a second, upon silver-bromide, that salt is partially decomposed, but the exact nature of this decomposition has not yet been fully determined. There is no visible change in the salt. There is a change in the atomic structure, however, which renders the silver-bromine affinity less strong than it was. Bromine belongs to the halogen group composed of chlorine, iodine, bromine and fluorine, which chemicals react in many instances in a manner similar to oxygen. All of them have a great affinity for the more common reducing (oxygen attracting) substances. However, in silver-bromide we have a compound of silver and bromine which is so stable that a reducer will not affect the bromine. If we subject the

silver-bromide to the action of light, the affinity between the silver and the bromine is so weakened that if the compound is then submitted to the action of a reducer, the bromine will leave the silver and go to the reducer. In this case there is but one possible result. Silver, metallic silver, remains where we had silver-bromide.

The photographic image is composed of an infinite number of minute areas of light of various intensities. This falls upon the gelatin-silver-bromide mixture which we call the emulsion. The light penetrates this translucent mixture to a depth corresponding to (a) the intensity of the light and (b) the time the light is allowed to act. If we allow the light a sufficient time for even the lowest intensity to affect the emulsion to a slight degree, it is evident that we have the silver-bromide affected throughout the exposed emulsion to degrees which correspond to the intensity of the various areas exposed. Thus in the case of a girl with a black trimmed white dress having been the subject, the image of the dress will have affected the bromide almost throughout the depth of the emulsion while the black trimming will have barely affected the superficial layer of the bromide.

Development.—If we now submit this emulsion to the action of a reducer, the bromide upon which the image of the white dress fell will give up practically all of its bromine and leave a full, heavy and opaque deposit of metallic silver. That portion which received the image of the black trimming will give up its bromine only in the superficial layers and we shall have a deposit of the thinnest possible layer of silver, which will have a visible effect of being a very delicate gray tone.

To fully understand this, we must think of the emulsion as having appreciable thickness, of having layer upon layer of silver-bromide granules suspended in the gelatin. After the process of reduction we have, not solid sheets of metal foil, but innumerable granules of metallic silver, suspended at various depths in the body of the gelatin. This is exactly what the microscope will reveal to us. Also, upon this fact depends the success of photographic processes.

Reversal.—And what takes place after this process of reduction is accomplished. In the case of reversal, the film is again exposed to light. It is evident that inasmuch as the original emulsion was of uniform thickness, there will remain an amount of unreduced silver-bromide which is in exact, inverse ratio to the amount of silver reduced. We expose the film to light and we decompose the remaining silver bromide. We then remove the metallic silver first reduced and then we reduce the remaining silver bromide. *It is evident that this second reduction must give us an image which is the exact reverse of the original.* This is roughly, the process of reversal.

Negative-Positive Process.—If, on the other hand we are making use of the negative-positive process we find that we have a film in which we have a perfect negative image surrounded by a *potential* positive image which is still light sensitive. If we are to preserve our negative, this potential positive must be removed, for if the film were to be exposed to light this positive image would gradually reduce from contact with the air under the constant stimulus of light. In time the positive would compensate for the variation in the density of the negative and we should have a solid black film.

Fixation.—After development, the film is placed in a solution of sodium hyposulphite (sodium thiosulphate) commonly known as hypo, which has the property of dissolving silver-bromide without having any perceptible effect upon the metallic silver in the time required for the bromide dissolution. This removes the creamy appearance due to the presence of the bromide and leaves only the silver grains suspended in the practically transparent gelatin.

Printing.—After this film is dry it is placed in a machine, quite similar in many basic mechanical ways, to the camera, and with a ribbon of fresh "positive stock" film lying in contact with it, the two films are run through the mechanism. During this, the fresh film is exposed to light, the negative being interposed between the positive stock and the light, thus acting as a stencil. The light will not penetrate the heavy black patches formed upon

the negative by white objects, while it passes readily through the thin gray areas left upon the negative by images of black objects. Where the light passes the most strongly we again have black and vice versa. Thus, our "positive" is a direct opposite of the "negative" and represents the object in its approximately true color values.

The positive stock after exposure to the light, is reduced or "developed" just as the negative was and then treated with the hypo or "fixed" just as in the case of the negative.

Thus with the two processes we arrive at practically the same end result. The only outstanding difference is that in case of reversal the same celluloid ribbon which was used in the camera forms our projection positive, while in the two film process the negative is used for printing only and an entirely different film is used for projection. The relative merits of the two processes are now discussed by authorities upon the manufacture of film and upon these two manipulations.

PLAYING THE PARTICLES

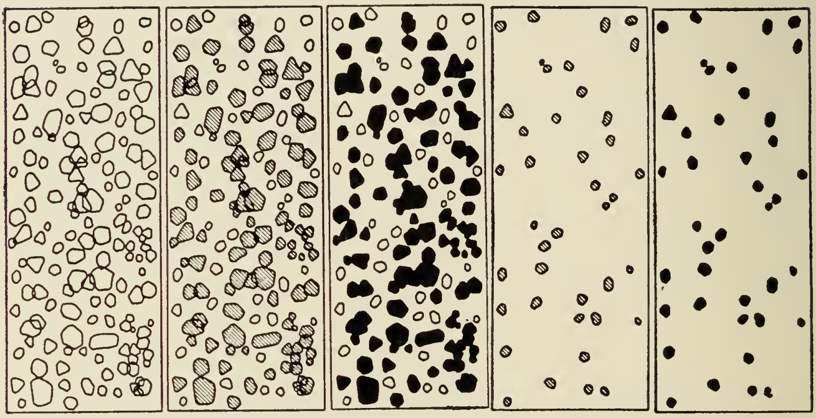
The very film which runs through the Ciné-Kodak is turned from a negative to a positive by the manipulation of millions of sensitive grains too small for a microscope to show.

(*Published through courtesy of the Eastman Kodak Company*)

It's a long way, in years and in progress, from daguerreotypes on our great-grandmother's mantelpieces to a casual hundred feet of home movies snapped at a picnic. During the time one of Daguerre's subjects sat in a rigid discomfort for a single exposure her less patient great-granddaughter can get the family motion picture camera from a table drawer, "press the button" to make an action picture of the children in the backyard sandpile—on bright days or dull—and put the camera away for thirty or forty more feet at the country club later in the week.

Yet, strangely enough, Daguerre and amateur movies have one important fact in common—both of them produce a positive image direct from the camera without printing from a negative.

But there is a vast difference in the way that result is obtained. Daguerre exposed in the camera a silver plate which had been treated with iodine to make it sensitive to light and then after exposure left it in a dark cupboard over a bowl of quick-silver. Where the light had acted, the quicksilver was deposited on the plate and made a white area, so that the finished daguerreotype reproduced the lights and shadows of the subject in the camera.



DIAGRAMMATIC REPRESENTATION OF THE REVERSAL PROCESS

Section 1 shows the grains unexposed to light. Section 2 shows the film after exposure, with the larger particles affected by the light. Section 3 shows the film after development—the negative stage. In Section 4 the black metallic silver has been bleached out and the film has been exposed to light. In mathematical proportion to the lack of brilliance of any area of the subject there is silver halide left on the film undisturbed by the bleaching. As soon as they have been developed out (Section 5) these remaining grains will determine the density of this area of film and its consequent function in causing shading on the amateur movie screen.

(*Courtesy Eastman Kodak Co.*)

THE REIGN OF THE NEGATIVE

But the next photographic process after Daguerre's, which was known as "Calotype," introduced an essential change. This process depended on the light sensitiveness of silver iodide deposited on paper. The silver iodide which had been exposed in the camera was developed with a solution containing silver. This silver was deposited in a black form on the paper, so that, instead of appearing white, bright areas of the subject appeared black. Therefore this calotype process produced in the camera, not a

picture ready for use like a daguerreotype, but a negative from which a print had to be made by printing through the paper. The introduction of the negative was a great advance in photography because daguerreotypes could not easily be duplicated. The possibility of making any number of prints was such an advantage that almost all subsequent photographic methods have involved the production of a negative.

But clearly, if it were possible to make a positive directly from the exposure in the camera and in addition to be able to print from that, it would be better to do so—because the negative is of no use in itself but is only a means to an end, whereas a positive which could be printed from when necessary, would usually not require printing at all, and material and trouble would be saved. In the case of amateur motion pictures this is particularly true; for of very many of these pictures only one copy is required, since the one can be projected over and over again.

In natural consequence, with amateur movies came the perfection of the "reversal process" of finishing movie film. The almost magical topic of how the reversal process turns the very film that has gone through the camera into a positive to be used in the projector is the subject of this article.

THE REVERSAL PROCESS

Photographic experimenters have worked on reversal processes for many years; but the process known previous to the introduction of the amateur movies suffered from serious disadvantages, the chief of these being that the result depended entirely upon exactly correct camera exposures. There was no way of compensating for errors of exposure. As will be shown later, this has now been overcome entirely, and the reversal process gives just as much control of photographic quality as is possible through making a negative—while no useless negative has to be made.

But perhaps the best way to delve into the operation of the reversal process is to look at the ingenious machine which actually develops and "reverses" amateur motion picture film after it has been taken from the camera. The

reel to be processed is fastened to a leader which slowly passes through an opening in the front end of the machine. Then it is carried in a series of loops through a deep, narrow tank of developing solution. The speed at which it travels is so adjusted that when the film emerges it has received precisely the correct development and is ready for a short rinse.

Then, without the "fixing" which would ordinarily be the next step, it is led into another tank, the "bleaching bath," where a drastic operation is performed. All the metallic silver which formed the negative image is removed, leaving transparent film except where the unexposed silver halide remains. Sounds like destructive treatment for motion pictures taken with care and eagerly awaited by their amateur takers! But don't worry. The process continues.

Actually the film is ready to begin its photographic life over again. The black areas of the film which the camera recorded from the white of the subject are all cleared away in proportion to their brightness, and the light of the movie projector can shine through white to the screen. The problem remaining then is to turn the original light areas of the film black.

A SECOND EXPOSURE

So as the next step the film is rinsed again and passes over a tray in the middle section of the machine, underneath which are dim yellow lights. That is to give a glimpse of the film as it passes. The room itself is otherwise dark. Then the film is given a second exposure under a white light of variable brightness, depending on the density of the film after the first exposure. This makes developable the silver halide which was not exposed originally and which therefore was not developed in the first developer so that it escaped the bleaching bath and is still sensitive to light.

Again the endless chain of film creeps into a developing tank and into a rinse. Then, this time, it is fixed. It passes into another series of loops through which warm air

(Courtesy Eastman Kodak Co.)

LATITUDE OF EXPOSURE

The great latitude in exposure which the reversal process makes possible is illustrated by these pictures. The three frames were made, reading from top to bottom, with the lens set at f 22, f 8, and f 4. If we suppose that the best possible exposure would have been made at f 11, then the f 22 picture had only a quarter of the normal exposure, while the f 4 had eight times the normal exposure. These pictures were processed with controlled second exposure in the usual way and then enlarged to give negatives so that the prints shown could be made. It will be seen that the wide variation in exposure given the original negative was largely compensated in the processing.

blows to dry it. Finally it emerges from the machine ready for spooling, inspection, and return to its owner's projector.

But this sight of the "reversal process" shows only what can be seen without a microscope. The genesis of the process and the refinement by which it gives excellent motion picture quality rest in the ultra-minute grains of silver halide suspended in gelatin on the surface of the film.

The behavior of the largest of them under the effect of light can easily be examined with a microscope. They are one two-thousandth of an inch in diameter or even larger. The smaller ones, those measuring as little as one two-hundred-and-fifty-millionth of an inch, have to be studied by other methods than sight.

THE PARTICLES' PART

An image on a film is really a mosaic of these infinitesimal particles—particles of silver halide before development, particles of metallic silver distributed in varying density after development. The grains of silver halide are not equally sensitive to light. Usually the larger ones are the more sensitive and the smaller ones are proportionately less sensitive. The stronger the light reflected by any part of the subject, the greater is the percentage of silver halide grains that will be affected in the area of film representing it. Therefore, the bright areas of any subject will affect all the large crystals of the corresponding part of the film and many of the smaller ones; the black areas will affect none; and an intermediary shade will turn perhaps only the very largest grains.

What happens to the film during its passage through the processing machine is shown in terms of particles by the accompanying five diagrams. They were drawn from photo-micrographs of Ciné-Kodak film.

Altogether apart from economy, this reversal process has several marked advantages. Most notably, it compensates for improper exposure to a striking degree and it practically eliminates graininess.

A SAFETY CUSHION FOR WRONG EXPOSURES

The second exposure of the film, controlled in accordance with the transparency of the film after it has been bleached, is responsible for the latitude which makes evenly lighted pictures on the screen even though the exposures have been uneven. (See the three photographs of a house.) If the original exposure was too great and overmuch of the silver halide was exposed and developed and bleached away, then the film is abnormally transparent and the second exposure is increased and brings out more of the remaining silver halide grains so that the final image will be of normal density. Conversely, if under-exposure followed by bleaching removed too little of the original silver halide, the second exposure is decreased so that too many of the remaining grains will not be developed and left to make an over-dense positive image. After the second development, the fixing operation removes the silver halide which still has not been exposed.

GRAININESS REDUCED

Graininess may be defined as the patchy appearance of the image on the screen, caused by the grouping together of the tiny particles of metallic silver. It is the larger of the ultra-minute grains and clumps of grains which cause visible graininess on the screen. This can often be seen when pictures are projected in a motion picture theater, especially from a seat in the front of the house. Because of its inherent characteristics, the reversal process greatly diminishes graininess. The larger grains or clumps of grains, which cause this graininess, are exposed in the camera most readily, because they are the more sensitive to light, and are developed and bleached out in the reversal process as shown in the diagrams. The final image is, therefore, made up of the smaller, less sensitive grains, which do not cause graininess.

DUPLICATES FROM POSITIVES

Professional motion picture companies still use negatives, because they make a number of prints of each pic-

ture. Yet even there the new reversal process is not at a disadvantage, for duplicate positives can be made equally well from reversed film. The original is run through a printer in contact with fresh, unexposed film. The result is a negative, just as though the duplicate were being made from the original subject; and, equally readily, the reversal process produces a positive. Thus amateurs can have two copies of a picture with the same amount of film that would be required for a negative and a print.

A hundred years since Daguerre!

The reversal process takes photography back to him in economy of material but a hundred years beyond him in effectiveness and inventive magic.

* * * * * *

DuPONT POSITIVE-NEGATIVE FILM

By E. M. Tobias, *Special Representative*
DuPont-Pathe Film Manufacturing Corporation

The sixteen millimeter amateur film now widely used by a majority of amateur cinematographers, was introduced on the market in the year 1924. The fact that the negative image made upon the film by exposure in the camera, was reversed by chemical treatment in the finishing process, to a positive image, cut down the cost of the film to a certain degree. By this process the same celluloid ribbon which was run through the camera formed the film for projection. This process was vastly different from that used with the professional (35 millimeter) film, which is a positive-negative process, as is the new DuPont-Pathe sixteen millimeter film. By positive-negative we mean that two ribbons of film are used for each picture. The ribbon which is run through the camera is developed as a negative, similar to the negatives secured from ordinary cameras. This film is then placed in contact with a second ribbon and run through a machine which exposes it to light and thus makes the positive film which is used for projection. This printing process is just like the printing process in ordinary still photography in which the positive is printed upon a piece of paper from a film negative, except that the print is made upon a second film.

The field of professional cinematography is about thirty years old, and in this work the positive-negative process has been used since the beginning. The idea of reversal of the image from a negative to a positive is not a new one, as the Autochrome process of natural color photography is many years old and employs the reversal process. That is, the negative image impressed upon the plate during exposure is reversed to a positive, the final picture being viewed as a transparency.

It is reasonable that if the reversal process is less expensive (as it is) than the positive-negative process, and that if other advantages were to be gained by its use that it would have been adopted by the professional motion picture producers. The fact that they have not done so, even for making single prints, is reasonable evidence that the process has grave disadvantages. Let us examine the various points of difference in the two processes in an effort to discover such disadvantages, if any.

As the greatest interest of the amateur lies in the picture as it is finally presented upon the screen, let us first consider the quality of the print and the resultant screen quality. The positive made from a negative by contact printing is remarkable for its wealth of tonal quality. It has a full scale of values from the deepest shadow to the highest light. In such a print the blacks are really black and not a muddy gray, yet at the same time there are visible details in deeper shadows and in higher lights than can be secured by any other process. In other words instead of shadows of uniform gray and immense areas of blank white, you have black shadows with detail showing in every conceivable tone of deep gray. You have delicate deposits of detail in the highest lights. In short quality is secured.

Probably few amateurs have given thought to this question of values, particularly as concerns the black areas of the film. The fact that a film has a long scale of tones, gives it a snap, life and brilliancy that is a much more faithful reproduction of the scene photographed than is a grayer print. Just for a test, go to your favorite theatre, watch the film closely as to brilliancy and tonal value.

Then go home and project your sixteen millimeter film. What is the difference? It is one of quality, the quality which makes the printed positive supreme. In this test pay particular attention to the blacks.

The quality of any film is directly concerned with exposure. If the exposure is too short or too long the tonal scale is degraded and the brilliancy of the film is lost. It would seem that this necessitates the determination of the exact exposure. This is not true due to a particular quality of the sensitive coating of the film known as "latitude." The latitude of a film means its ability to register the correct tonal scale of the scene photographed when exposed for different lengths of time. The latitude of an emulsion is to a certain degree, dependent upon the thickness of the emulsion upon the celluloid. The negative film and positive film used in the positive-negative process both have a heavier, "richer" emulsion than is used in reversible film. This means that the cinematographer does not have to be as careful in calculating his exposures as he would otherwise have to be, and that his finished film will have a richer silver deposit and hence a greater tonal range. In addition to these features, an even greater latitude of exposure is secured through the printing control, where the intensity of the light used in printing may be regulated to any degree. These points make it easy for the amateur to secure good film without having to make an expert determination of the light used. The printing control makes it possible to correct over and under exposures to a remarkable degree.

Then there is the question of a master negative. It may be assumed that any film made by the amateur is a film which is desired for future use. In fact the value of any film increases with age. Contrarily the physical quality of the film passes with age. If we use reversible film we must have duplicates made when the film is new and fresh. If we do not do this, the duplicate when made will show every break, crack and scratch which is upon the original film, and such defects will occur in every film used for projection. If the duplicate is made at the time of the development of the original, it is aging and becoming hard

just as the original is. In the positive-negative process we have a master film upon more flexible and longer lived film, which is never subjected to the drying heat of the projector, which is not scratched and torn by projection, but which is stored away and never used for any purpose but making positives. The ordinary films you make to-day cannot be projected twenty years from now, but your great-grandchildren can make prints from your master negatives. In addition to this, the duplicate from the reversed print is more expensive than a print, it has even less quality and detail than the original, and is rarely satisfactory.

We are all familiar with the clatter-clatter of film splices running through our projectors. In the positive-negative process, the cutting and editing is all done on the negative so that we can print upon one continuous ribbon of positive film. This means that our entire film may be run through the projector without having a single splice in it, nor will a splice ever be necessary unless through accident the film is broken.

DuPont positive stock is available in different colored celluloids, such as amber and light amber. Prints made upon these films have a warmth of tone and richness of appearance which can never be secured from a black and white print. It is true that films may be tinted in any desired colors, but the process entails an added cost which is not encountered in the use of colored bases. It is only a question of time until this film will be supplied in a full range of colors.

Another incentive toward the use of the negative film is the recent introduction of panchromatic negative stock. This film is sensitive to all colors and does not give the false color values seen in the ordinary picture. It makes possible the production of attractive pictures without the use of make-up, and makes the use of incandescent lights entirely practical. This film opens up an entirely new field to the enterprising amateur. He can shoot through a red filter and secure beautiful moonlight effects in the middle of the day, scenes which have all of the soft quality and delicate transparency of shadow of real moonlight.

Last but not least, it makes possible the truthful reproduction of beautiful landscapes with their wealth of the most delicate gradation, and with the creamy clouds floating in a darkening sky. Sunsets and flowers in their full riot of color are imaged with their full range of tone. This film alone is full justification for the use of the positive-negative process. In fact, for the amateur who is working seriously and who desires the best possible results, the positive-negative process holds tremendous possibilities.

* * * * * *

After reading these two articles I am sure that you will agree that the question of reversal versus two-film is not a question of superiority but rather a question of choosing the film which is best suited for the work in hand. Thus the film of casual interest could be made upon the reversal film, while the film in which color value is of importance could be made upon panchromatic negative stock. The two films, while competitive, should help each other, for after all a purchaser of any commodity prefers to have a choice in the matter rather than to be forced to purchase just one definite thing.

There is room for both films in amateur cinematography, both serve definite purposes and neither could be dispensed with without the loss being felt.

In addition to the arguments set forth in the two articles just presented, there is one other which must have been made apparent. The reversal process, while it has time after time been successfully performed by experimenters is not as practical for the home finisher as is the two film process. Simple negative development is a fixed chemical reaction and there is no reason whatever why any amateur who cares to do so cannot develop his own negatives.

Development of the Negative.—In either process, the development of the negative offers little difficulty, it is the exposure and development of the positive which requires the care. In the two film process, a loss of the print means only the loss of the film stock, for the negative, the master film, is not injured. In addition to this, the only control

that need be exercised in the two film process is the light control in printing. So, the amateur who desires to develop his own film may easily do so, provided he equips himself with a few simple accessories.

Home Developed Film.—It is only fair to state at this time that the home developed film will not be in any way superior to the commercially developed film and in most cases it will be inferior. The saving in money will not compensate for the time and trouble involved—*but* there is that ever growing class of amateurs who love to dabble in laboratory work, who derive from development the greatest imaginable pleasure. To them this chapter is addressed, and because of them, suggestions are made which would never be made in a strictly practical chapter dealing with the most efficient and economical development, for that is, as has been said, commercial finishing.

Relation of Exposure to Development.—Before going on with the discussion, let us again consider the supreme importance of proper exposure. Reference to the diagram in the appendix of this book will show the exact effect of exposure and of development. This chart will show that manipulation in ordinary development can never compensate for errors in exposure. It is true that special development will produce changes which may pass for such correction, but a comparison of such a manipulated print with one correctly made will immediately demonstrate the superiority of the properly made film. You cannot expect satisfaction from the development and printing of your films unless you pay careful attention to exposure and make intelligent use of an exposure meter.

We have noted the general effect of development. We have seen that a reducing agent will take the bromine from silver bromide leaving metallic silver, *provided the bromide has been exposed to light!* This is true, but the process is hardly as simple as that. It must be evident that in a balance so delicate that light will disturb it, there will also be other stimuli which will produce the same effect. This is true. Excessive dampness, chemical fumes, heat and many other stimuli will cause the same bromide decomposition. Therefore we have to make use

of a fairly fresh film (not more than one year to eighteen months old), and we must protect this film from chemical fumes, excessive heat and dampness. When we are ready to develop the film, we find that our reducer will reduce a considerable portion of the unexposed bromide, so we cannot use a straight reducer solution. Experiment and research has shown that the following elements are essential in almost every successful developing solution.

Reducer.—This is the active developing agent. We have many kinds, such as metol, hydroquinone, amidol, pyrogallic acid, edinol, kodalon, elon, rhodol and so forth. These agents have different qualities, most of which depend solely upon the rapidity with which they act. Amidol will work without the presence of a caustic alkali and is therefore suitable for high temperature development, and so forth. It may be said however, that the principal differences among developers are those of rapidity of action.

Preservative.—A chemical reducer is one which has a strong attraction for oxygen. As one of the greatest sources of oxygen is the air, it is evident that the reducer would rapidly remove oxygen from the air and thus become rapidly saturated and useless for our work. Therefore we add a *preservative* which tends to prevent this and which keeps the reducer fresh and strong even when freely exposed to the air. The preservative commonly used is sodium sulphite. (Note carefully the suffixes of chemical names as *ite* means an entirely different chemical than does *ate,* while *ide* is still another. Thus we may have sulph*ite,* sulph*ate,* sulph*ide.* Watch this if you expect to avoid inexplicable results in connection with your development).

Accellerator.—We have seen that the bromide is suspended in a gelatin coating. Gelatin is hard and horny and remains so until it has been exposed for some time to the action of water. A sheet of gelatin will swell upon the surface to such an extent that it begins to go into solution before the center becomes even softened to any appreciable extent. In development, it is highly desirable that the developer reach all portions of the gelatin as nearly simultaneously as possible. To accomplish this we add a caustic alkali to the reducer. This caustic acts

upon the gelatin, partially decomposing it and so allowing the developer to gain almost immediate access to every stratum of the emulsion. This enables us to secure complete development without excessive reduction of the bromide in the superficial layers, which we call "fog." Fog will ruin the brilliancy of the finest of films. Prolonged development will result in fog, so the deepest stratum must be practically fully developed before the superficial layer begins to fog. The usual accellerator is sodium carbonate.

Restrainer.—It appears absurd to add a restrainer to a solution which has just had an accellerator added. However, the restrainer restrains, not the gelatin penetration, but the reduction itself. Thus we see that the restrainer acts in conjunction with the accellerator, as it restrains reduction, still further preventing fog in the superficial strata before reduction occurs in the deeper. The restrainer is usually potassium bromide.

Other constituents added for special purposes and usually in small quantities are citric acid, alcohol, formalin and so forth. Actual formulae for the various solutions needed will be found in the appendix.

You will need for this work a room which can be made thoroughly dark, and one in which running water is available if possible. In the absence of such convenience, almost any room may be used after nightfall. In the way of equipment you will need:

- 3 development tanks (as the Stinemann equipment is the only equipment available at this time for the home development of 16 millimeter films we will assume that it is to be used)
- 1 film rack for development (2 racks are even better)
- 1 drying rack
- 1 16 millimeter printing machine

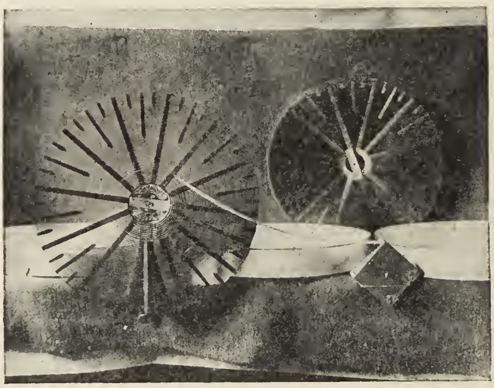
You will also need small items of equipment including:

- 1 4 oz. graduate
- 1 32 oz. graduate
- 2 stirring rods
- 1 thermometer

1 safelight
1 darkroom timer
1 pair scales
1 assortment chemicals.

The first step is to make up the desired quantity of developer and of hypo solution as indicated in the various formulae. These are poured into their respective tanks which should then contain about two inches of solution or a trifle less. The third tank should be filled with water to which a small quantity of glacial acetic acid has been added. This is the "stop bath."

The next step is to extinguish all white lights and turn on the red or "safe" light. Every step must be carried out with this as the sole illumination until the film is ready for washing.



A Stinemann developing rack partially loaded with film.

PROCESS OF DEVELOPMENT.—The film rack is placed upon its supporting pin which has been clamped to the table edge for this purpose. The camera spool should be placed upon your rewind and this clamped to the table near the rack. The film is now pulled from the spool until the paper is all unwound and the cream colored film itself becomes visible, the paper is torn off and the end of the film itself is now secured, *at the center of the spiral*, by means of the small hook provided for the purpose. The reel is now rotated by the left hand while the right hand guides the film into place. *Caution!* Be sure that the dull

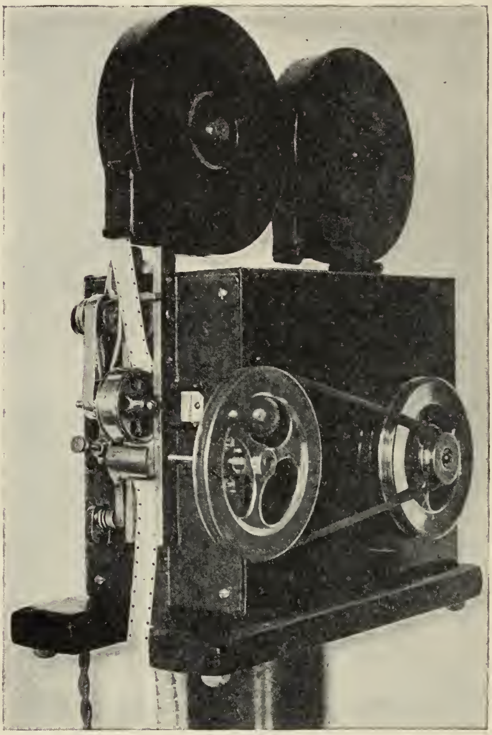
side of the film is on the *outside* and the *polished* side on the *inside in contact with the metal spiral!*

When the film is in place, secure the outer end by means of a film clip. Now, grasping the reel by the cross bar in the center, remove the reel full of film from the support. Take it to the table where the tanks are arranged. Place the reel full of film in the developer, lowering it gently into the solution. Start the timing clock and then raise and lower the rack a few times in the developer, in order to remove all air bubbles. Do this as rapidly as possible without causing any splashing or bubble formation. Continue this for perhaps thirty seconds, then throughout the course of development give the rack a short lift every thirty or forty-five seconds.

When development is complete, that is when the timer alarm rings, remove the film, rinse it in the stop bath for perhaps ten seconds, then place it in the fixing bath where it remains for twenty minutes. At the end of this time, turn on the white lights. Pour out the stop bath and use tray No. 3 for washing. Place the film in this tank and rinse four times. Place the tank beneath the faucet and allow a small stream of water to run into the tank for a half hour, the overflow running off through the drain.

At the end of a half hour, release the film ends from the rack, raise the rack from the water, place the wire screen which comes with the tanks upon the top of the film. Now holding the screen and rack together with the hands, quickly reverse the whole and replace in the water. Lift the rack from the tank. It will come up leaving the film loosely coiled upon the screen. The rack is shaken to remove any surplus water and hung up to dry. The screen bearing the film is now removed from the tank and gently shaken to remove surplus water. The outer end of the film is attached to the drying rack. This rack is rotated, the film being wound around it, between the pins upon the cross bars. The film is attached to the rack by means of the spring film clips. When the film is all on the rack, the second end is secured as the first one was and the rack is rapidly rotated a few seconds to throw off any surplus water. The rack is now hung up to dry, its

position being reversed every few minutes to secure even drying. When the film is thoroughly dry it is ready for printing.



The Stinemann 16 m/m printer designed for amateur use.

PRINTING THE POSITIVE.—Before using the negative for printing it should be carefully examined to see if any marks have been left upon the polished side during the process of drying. If such marks are present, the film must be polished before being printed.

For polishing, a pad of chamois skin, dampened with alcohol, is used. The film is run slowly between the rewinds, and as it is drawn from the supply reel it is run, dull side down, over a pad of clean white cloth spread upon the rewind base. The chamois pad is rubbed briskly along the polished surface with a scrubbing action. This

will remove any dry marks and leave the film is the best possible condition for printing.

The film is wound up on a rewind, using a wooden core for this purpose instead of a regular reel. It is slipped from this core and placed in the rear one of the two printer magazines. It is so placed that the polished side will run down through the printer mechanism in contact with the front wall of the machine itself. The positive stock is placed in the front magazine. It is now threaded through the printer mechanism with its dull side in contact with the dull side of the negative film. A few turns are now given to the handle, and the positive cut off and developed. Repeated tests of this kind made with various sizes of light aperture in the printer will soon indicate the proper width of the light aperture for this particular negative. Then the entire scene is printed by turning the crank at a uniform speed using this aperture.

As the density of the negative varies with different scenes, this test will have to be repeated for each scene. The change of scene is shown by watching the film through the "safe" window provided for this purpose in the front of the printer. After some practice you will be able to judge the proper printing aperture to be used by the appearance of the film as it passes through the machine, but at first each scene should be tested. This film is now developed just as the negative was. All operations of both printing and developing the positive must be carried out in red light.

The actual threading of the printer should be done in strict accordance with the detailed instructions supplied by the manufacturer.

Trick Printing.—Some very effective trick work can be done by the careful worker using a good printing machine. For example, to produce a film showing a child walking through a crowd of huge ants:

Using the six inch lens, reflex focusser and lens extension photograph an ant hill so that the ants will be almost half "man" size upon the screen. Make this scene at high speed. Try to arrange to get no ants in the immediate foreground. With a stick, and by pulling up grass, make

a faint path. Note carefully the position of this path in the focusser. Now upon another film make a picture of a girl walking down a path so that she follows about the same direction as in the small path in the ant picture. The effectiveness will depend upon the exactitude with which the two paths coincide. Make this shot with either a white drop or the sky as background. Develop both films, calling the ant hill film one and the girl film two. Film two is developed to give an absolutely opaque background. Print film two so densely that you have a black figure in a colorless background (negative) this is film three. Now thread the printer using film one as the negative, but between this and the raw positive, film three is placed to act as a mask. Before starting to print cut a notch at the edge of the films, and through all three films. This notch indicates the relative positions of the films and is called the "registration mark." Print this film, but do not develop the print. Now carefully register films two and three and in film two make a notch to correspond with that in film three. Thread up the printer, having rewound the printed positive. Register the notches and print again, using this time *only film two* as a negative. Now develop. If the work has been carefully done and the printer in good condition, the two sets of images will register and you will have the effect described. Film three is only a mask, preventing film one from printing in the space to be occupied by the image in film two.

White fades may be made by gradually closing the printing aperture while printing. In this effect the picture fades out until the screen is white instead of black as is the case in the usual camera fade.

Ordinary or "black" fades are made by gradually opening the printing aperture and then gradually slowing printer speed, thus giving an increasing over-exposure to the print.

There is one stunt which the experimenter can use to very great advantage. This is the copying of still pictures of various kinds for inclusion in his films. Anyone who can make a title can do this work. Select the picture desired, make a regular title set-up and make the exposure.

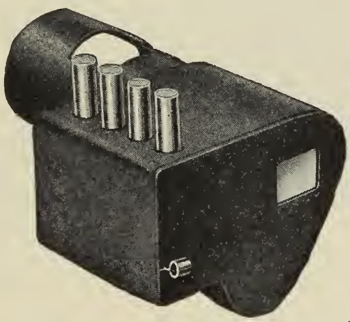
This is now widely used for incorporating old family portraits in the family record film.

For further suggestions in this work, the reader is referred to any good work on professional cinematography such as the "Handbook of Motion Picture Photography" and "Motion Picture Photography," published by the publishers of this work.

TINTING AND TONING

AMATEUR FILM

Perhaps the greatest fault of the present day motion picture in the home is its monotony of color. The endless repetition of black and white, particularly when the tones are not rich, wear upon our nerves. For this reason, the various systems of color filters for projectors have been placed upon the market. There is no question but that the amateur should tint and tone his films or use one of the better types of color filter sets. This is particularly



(Courtesy American Ciné Products Co.)

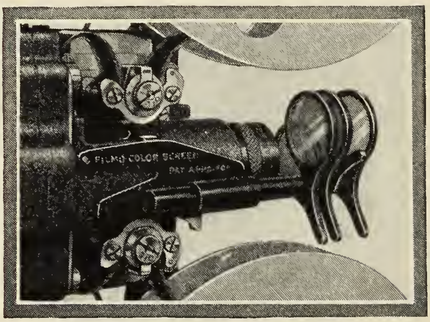
The American Colorator which with four color screens of optically plane glass provides fifteen color tints for projection. Pressure upon any button or combination of buttons locks the corresponding filters in position. Pressure upon the release or upon any other button or buttons automatically removes the first ones from the field. This device may be used with any modern 16 m/m projector and adds greatly to the pleasure of projection.

true in view of the fact that the process of tinting and toning, in many cases, results in intensifying the film, giving us richer tonal values than the original black and white image possesses.

The color filters mentioned have one great advantage.

The tint of any scene may be changed at will and when the largest possible screen size is desired, all color may be removed, giving added illumination.

In the chapter dealing with projection we discussed the disadvantages of the black and white image upon a silvered screen, and there we considered the color screens. The process of tinting a film serves the same purpose. Tinting a motion picture film is merely a process of dyeing or staining the emulsion with any chosen dye. While there are a number of troubles which *can* occur, there are few which actually confront the careful worker. The only thing to be watched is the depth of the tone, and care must be taken to prevent uneven dyeing. The Stinemann developing tanks are ideal for tinting and toning, as this system allows uniform dye or toning bath penetration and makes uniform work easy.



(*Courtesy Bell & Howell*)

The Filmo projector color filter attaches to the Filmo projector as shown here. With this device any one or any combination of the four color filters may be used to give the projected film a tinted effect.

If we start with a film which consists of black deposits of silver upon a transparent celluloid base, it is evident that the various tones of gray are due to partial transparency of such gray areas. If we stain the emulsion with a dye, red for example, it is evident that we shall have a film in which red replaces white in all proportions. That is, the deepest shadows may remain black (opaque) but all halftones and highlights will be shown in some shade of red. In this case the halftones are composed of red and black (dye and silver).

If we start with the same black and white film, and instead of a dye, treat it with some chemical which will turn the deposit of black silver to a solid deposit of some other color, our deepest shadow will be the deepest shade of the color, red for example, to which the deposit is turned. In this case the halftones will be composed of mixtures of red and *white* or just the reverse of the dyed film, while any pure highlights will be white.

In this process, we have secured a color effect by means of two processes which are diametrically opposed. It follows therefore that we can use both processes upon the same piece of film. Let us consider a pink dye and a blue tone.

Starting with the black and white film, we tone it blue. This gives us a transparent film with a blue image. This will have a very attractive appearance, particularly if the scene is an early morning marine. When this film is dry, we tint it a delicate pink. If this film is now projected we shall have deep shadows in pure blue, halftones in violet tones and highlights in pink. Upon the screen such scenes are quite often mistaken for natural color films so perfect is the gradation and color value.

The tinting bath is a mixture of water and aniline dye. The dyes used may be obtained from the Eastman Kodak Company. The proportions used are given below:

Ciné red Water	1.3 ounces 2 gallons	Dye for 3 minutes at 65° to 70°
Ciné scarlet Water	0.5 ounce 2 gallons	" " 3 " " " " "
Ciné orange Acetic acid Water	0.26 ounce 0.13 ounce (glacial acid) 2 gallons	" " 1 " " " " "
Ciné yellow Acetic acid Water	0.5 ounce 0.13 ounce (glacial acid) 2 gallons	" " 1 " " " " "
Ciné green Water	1 ounce 2 gallons	" " 3 " " " " "
Ciné blue Water	0.5 ounce 2 gallons	" " 3 " " " " "
Ciné violet Water	0.5 ounce 2 gallons	" " 3 " " " " "

Each solution will dye about 1,000 feet per gallon before exhaustion.

An earthenware or glass vessel is used for mixing the dye. For two gallons heat the dye in one pint of water, stirring until solution is complete. Filter this solution through fine muslin into the tank, then pour one more pint of hot water through the residue in the filter to remove all dye from the inert "filler." Then make up the dye to the proper volume, i.e., two gallons, with cold water. The film is agitated in the dye bath to secure evenness of tinting, and to remove any air bubbles which may accumulate. After dyeing for the requisite length of time, the film is rinsed in clear water for about five minutes. After rinsing it is drained for a minute or two and immediately placed upon the drying rack. In placing the film upon this rack, or immediately after, it is wiped with absorbent cotton, the accumulated water being pressed from the cotton at short intervals. It is important that a sufficient quantity of water be removed to prevent the formation of any drops upon the film. Such drops of water become saturated with dye and form an ineradicable spot of color upon the film. This is known as bleeding. Also the film should be dried in a room of fairly high humidity, as film dried rapidly in dry air has a tendency toward uneven coloring.

It must be taken into consideration that the brilliancy of our screen image depends upon the percentage of the total light which is transmitted by the film. Tinted film shows a loss of transmission ranging from 25% to 95%, so that we must act accordingly. A rather light film should be used for tinting, but as the tendency of amateur film is toward thinness rather than density, the average amateur film is about right for a light tint.

Tints must be used sparingly. A heavy vivid color is rarely satisfactory. The very delicate tints which give a perceptible "screen effect" without perceptible, or at least without noticeable positive color are the best. The tint should partake of the nature of the scene. About 95% of the professional films are tinted, yet the spectator is rarely conscious of this fact. The exceptions are deep

red for fire scenes, deep blue for night effects and at times a deep green for forest scenes.

As has been said, the tinted base film gives all of the effect of tinting, and no doubt 16 millimeter film will soon be available in all standard tints, relieving us from dye tinting. The tinted base stock is sufficient for all purposes and in most ways superior to the dye tinted film. Until it is made available, however, and in the case of existing films, the tinting bath must be used.

Film which has been projected should be immersed before tinting in a bath made of one-half pound of sodium carbonate in two gallons of water. This is for the purpose of removing grease and dirt from the film. Without this bath, a film which has been projected will undoubtedly dye unevenly. After the carbonate bath the film is washed thoroughly and dried before tinting. The carbonate bath should be of from two to five minutes duration. In case of heavy oil or grease deposits, the film may be gently rubbed between the thumb and finger.

The treatment for toning is entirely different from that of tinting, nor is there any substitute for the toning process, as there is for the tinting. In toning we have three basic tones, the uranium, iron and sulphide. The sulphide is the familiar "sepia" tone of still photography. In this case the film is bleached in a bath which re-converts the metallic silver to silver bromide. This is then treated with sodium sulphide which changes the silver bromide to silver sulphide. (Do not confuse the sulphides with sulphates or sulphites.) Silver sulphide in thin layers appears brown by transmitted light, but a heavy deposit is opaque and hence black upon the screen although brown when held in the hand and looked at by reflected light. It is therefore necessary to start the sulphide tone with a thin or medium thin film.

The uranium (cold chocolate to red chalk) and the iron (blue) tones are accomplished by the use of single solutions. They also exert a slight intensifying action, so that medium to thin films are best suited for this work. Here again we find the average amateur film very well suited for the work in hand, so that we find that the quality of

the film, color considerations aside, is enhanced by both tinting and toning.

SEPIA TONING

Bath A

Potassium Ferricyanide	6.00 ounces
Potassium Bromide	1.33 ounces
Water to	2 gallons

Bath B

Sodium sulphide (crystals)	1.33 ounces
Water	2 gallons

The film is bleached in "A" until the image appears uniformly yellow from the rear. It is washed 5 minutes and placed in "B" until thoroughly toned. The film should bleach in from two to four minutes at 65 to 70 degrees, and should sulphide in from ten to fifteen minutes.

IRON TONING

Ammonium Persulphate	57 grains
Ferric alum (ferric ammonium sulphate)	145.5 grains
Oxalic acid	352 grains
Potassium ferricyanide	110 grains
Ammonium alum	581 grains
Hydrochloric acid	2 fluid drams
Water to	2 gallons

Each of the solid chemicals should be dissolved separately in a small quantity of warm water and the solutions allowed to cool. They are filtered into the tank *in the order given,* and the whole diluted to the required volume. If this is done the bath should be perfectly clear and of pale yellow color.

The film will tone in from two to ten minutes at 70 degrees F. The tone varies from a light bluish-gray to a deep, pure blue.

After toning the film is washed for ten or fifteen minutes until the highlights are clear. A slight yellowish tinge may remain but this is not important. The bath

will tone about 400 feet of film, and by addition of 2 drams of acid a second 400 feet may be toned and then by another addition of the same quantity of acid a third 400 feet may be toned, giving a total toning power of 1,200 feet of 16 millimeter film for the bath.

URANIUM TONE

Uranyl (Uranium) Nitrate	300 grains
Potassium Oxalate	300 grains
Potassium ferricyanide	110 grains
Ammonium alum	726 grains
Hydrochloric acid	10 fluid drams
Water to	2 gallons

Mix in order given. The solution should be pale yellow. The film will pass through a range of tones from brown to red in about ten minutes. When the desired tone is reached, the film is removed from the bath and washed for ten or fifteen minutes, or until the highlights are clear, or have at most a slight yellowish tinge. The bath will tone about 400 feet of 16 millimeter film.

DOUBLE TONING

A deep, dull green particularly suited for forest and similar scenes may be made by toning in uranium for about 3 minutes and then in iron for about 2 minutes, followed by the usual washing.

Uses for Tints and Tones.—The amateur may be at a loss to know just what tint, tone or combination to use in any particular case. There are no hard and fast rules, but we may give a list of some appropriate scene colors.

	Tint	*Tone*	*Combination*
Fire scenes, furnaces etc.	red		
Forests	green	green	blue-amber
Interiors	pink-orange-lavender		uranium-yellow
Sunlight exteriors	amber-light amber-yellow	uranium-sulphide	uranium-yellow
Dawn and sunset	pink	blue	blue-pink
Mountains	light amber	uranium	uranium-iron

One of the best guides to the use of tints and tones is the study of films as they are shown in theatres. There is no question but what the tinted film is at least fifty per-cent superior to the black and white film, while the toned film and the tinted and toned film are even better.

While some of these steps are difficult, the amateur will be amply repaid for any time he spends in this work.

(Data on tinting and toning given through courtesy of Eastman Kodak Company.)

PART TWO

The Amateur Producer

CHAPTER TWELVE

The Art of Cinematography

The camera is the tool of the artist, and its manipulation constitutes his technique. However, there is a deeper significance to cinematography than mere perfect technique. That is something which anyone can attain provided enough effort and patience are given to the work. A worth-while motion picture composition is a result of the combination of perfect technique and the creative spirit of the artist. Cinematography is beyond any question a potential art and the artist-amateurs will no doubt excel in the production of good films.

The motion picture film is a chemically produced record of a certain scene. This may be a machine, an animal or a landscape. It may be anything physical. However, if the component parts of that picture are so arranged and so move in relation to each other that we feel certain emotions which are not in any way pictured upon the screen, if we feel something of the impulse which motivated the producer of this scene, that picture may well be said to be artistic. Art is after all only the concrete expression of an abstract emotion, and is usually a matter of "atmosphere" and "suggestion." The delicacy and subtilty of such expression is usually a gauge of its worth as a work of art.

It has long been the fashion to ridicule the idea of any artistic worth in connection with motion pictures, yet in the motion picture we have, potentially, the greatest art which the world has ever known. The motion picture, artistically considered, is not a photographic record of dramatic art—or at least it should not be. No art can ever be fairly judged by the standards of the technique of another art. It is neither just nor sensible to judge

the motion picture by the standards of either painting, drawing or drama. It is a new and entirely distinctive art whose primary purpose is the presentation of motion which is in itself attractive. In design we have lines which of themselves are pleasing—motion picture design represents a point travelling over that path which will, if made permanent, reproduce the pleasing design of the still picture. In the motion picture we have the static made dynamic, and to the modern individual particularly, the dynamic is always the more appealing.

We cannot expect to look to the *present* professional screen for any revolutionary changes in motion picture technique. Most of the actors of to-day have a theatrical background and are slaves to theatrical technique, those who have not, have adopted such a background from the "old-timers," the veterans of the repertoire companies of past years. This technique is beyond all shadow of a doubt unsuited to the motion picture. In fact it is so entirely unsuited that it has been proven impossible, so we have the modern monstrous hybrid known as "movie art."

It lies with the amateur to bring the motion picture to its true status. That is, if the amateur will hurry. There are very hopeful signs within the industry at present, but these signs are appearing from that much abused organization, the Motion Picture Producers & Distributors of America. This organization is striving, and spending huge sums in their efforts, to provide better and more artistic pictures for you. From them, not from the actors, or camermen, may come the truly artistic motion picture, even before the amateur has shown the way.

Inasmuch as the amateur either directly, or indirectly led the way to most of the worth-while improvements in still photography, more particularly as concerns the exhibition and other artistic pictures, it is not too much to hope that this history may be repeated with regard to the motion picture. For this reason, and in the hope that a hint may be given which will indicate the proper direction for experiment, this chapter is included in this book. Moreover, even failing in this, there is no doubt that the effort spent by the amateur in trying to produce the good

film will result in a much higher average quality in amateur films in general.

The name of Colonel Roy W. Winton, who is the managing director of the Amateur Cinema League, is probably known to every amateur in the country. At luncheon one day he remarked that the motion picture was essentially "unlimited motion dramatically applied." Let us study that statement carefully, for therein probably lies the secret of the motion picture art.

Unlimited motion means just that. There is no limit to the duration, direction or speed of the motion depicted. The dramatic application is however a more serious question. Drama as we are familiar with it, is merely the dramatization of life. A series of situations from life are so assembled that there is not only a distinct continuity of action, but each succeeding scene is more portentous and has a deeper significance than the preceding one. This definite rising scale serves to raise our emotions in relation to its own progress. Finally we have the scene of the greatest importance, the culmination of the various sequences of the drama, and with a very brief finale to bring the theme to a fitting close, our drama is ended. Many dramas may be made directly from life without other alteration than the stripping away of extraneous detail and the condensation of the time elapsed into a relatively short period.

What of the dramatic application of motion? In pictorial art of the still variety, we have more or less elastic, yet definite laws concerning composition. Any variation of the position of an object may easily cause the destruction of a fine bit of composition. Obviously then we must discard static composition when we come into the consideration of motion picture art. We must use motion so dramatically that we create dynamic design, composition in motion!

To do this we must give some little study to motion, abstract motion! We will find that any type of motion will give rise to a corresponding emotion or mental interpretation, and what is still more important, this type of motion will always stimulate similar mental reactions.

There is nothing haphazard nor arbitrary about this. We may observe two men sitting upon a bench. We will accept the statement that they are identical in appearance. They rise and walk away, and then we make the statement that one is energetic, purposeful and with a driving personality, while the other is calm, self-possessed and probably an accomplished idler. Both may be gentlemen in every sense of the word, charming, polished and with all social virtues, but their *motion* reveals two entirely different personalities. In this we approach unconscious dramatic motion.

The most common good example of cultivated dramatic motion will be found in well trained aesthetic dancers. In modern times there is too much tendency to confuse the acrobatic and ballet dancer with the interpretative dancer. The interpretative dancer does not sway, nor jump, nor bounce about to a syncopated rhythm. Rather, she glides, hesitates, leaps, her body responds instantly and completely to the scintillations of her mood, and the music is or should be but an accompaniment to the changing mood of the dance.

Dramatic motion is not necessarily, in fact it necessarily is not, harmonious motion. Harmony and drama are incompatible. Dramatic motion includes harmonious sequences abruptly broken by crashing discords, as the interpretation demands. This is the most apparent difference between the interpretative and the ballet dancer. At any rate, we find that it is possible to convey a definite impression, to interpret a definite emotion through the medium of motion alone.

Shall we then devote our screens to films of Greek dancers? Hardly! The interpretative dance is but the raw material from which we reconstruct the dramatic action.

Just what then, is the artistic motion picture as we may expect to see it upon the screen? It is not, after all very different from the usual modern type of picture. In the usual picture to-day the whole interest is centered in the *story;* to use a far fetched simile, it is as though a song were sung for the words alone without regard for

the melody. We must have a story, it is true, but with this difference, it must have the "melody" of dramatic action to carry the story along. We do not need nearly so much of the melodrama as is now commonly used. In fact many simple stories which would be "duds" under the present method of production would make photodramas of such appeal that they would transcend in grandeur the most spectacular million dollar production ever recorded upon celluloid.

This idea is not entirely foreign to present day practice. The modern actor is inclined to place too much responsibility upon his facial muscles. He "registers" an emotion rather than "interpreting" it with his whole body. He often carries a funereal face hung grotesquely upon a laughing body. If our modern actors and directors could but learn to make the actor "all face," if they would but study the soundly founded scientific phases of emotional motion, and if the cameramen would learn to substitute dramatic lighting for decorative or novelty lightings, the long step would be almost completed.

As the ridiculous and the sublime are often separated only by a hair, so the artistic motion picture drama and the present "chromo" method are so nearly alike that there will be many individuals who will not be able to discern the new from the old, but when this millenium does appear, and we have motion pictures which use true dramatic motion instead of the existing theatrical interpretations grafted upon a photographic process, we shall find that the highly cultured people who now are indifferent toward or antagonistic toward the motion picture will give it their support and that the motion picture will finally be enthroned in its proper place, as the greatest as well as the youngest, of the fine arts.

So much for theory. What about actual practice? There is nothing definite which can be said concerning the production of the ultimate photodrama by the amateur. But there is a wide field for experimentation. For example, a group of students of this problem made a 100 foot (16 mm.) reel which endeavored to portray a definite sequence of emotions, the faces of the actors being obscured

to such an extent that facial interpretation was impossible! The results were not perfect by any means but they were interesting and gave promise of much that might be of great interest. Such experimental work as this is to be recommended for use by the amateur and there is little question but that something of value will arise from such work.

Perhaps the first step will be the compilation of a dictionary of motion. This dictionary will consist of from 400 to 2,000 feet of film divided into short scenes, each of which illustrates some basic action. In making this, the emotion is first of all determined. When this is done, a suitable style of motion is decided upon and this is rehearsed until it is perfected. Then, and then only the actor will perform before the camera. In this way the various actions will not only become familiar, but a permanent record will be made which can be referred to at any time.

No detailed instructions will be given for these actions. This is something which is not yet fixed by convention and each experimenter is at full liberty to work as he sees best. Some of you will evolve the perfect motion interpretation for one or more emotions. When this is done, perhaps the convention must be established.

Just remember that curves are harmonious, angles are discordant. Vertical motion gives the impression of dignity and grandeur, oblique motion is strongly dynamic while horizontal motion is calm and of more stative character. Smoothly continuous action corresponds to the curve while an intermittent, jerky motion is analogous to the angle.

It is admitted immediately that such an interpretation is not according to the existing facts of actual life, but we are not dealing with a portrayal of life—that is the present status of the motion picture. We are dealing with art, which is a representation of an emotion. Let us take the opera for example. It is admitted to be the highest form of dramatic art. Do we ever, in real life, find groups of people wandering about singing of their innermost secret troubles? Hardly! Yet this fact does not take from

grand opera the slightest portion of its attractiveness.

In our film play we may have a villain. He is not an individual of questionable character—in our drama he is evil, the personification of abstract evil! His make-up itself carries out the idea. Here let us refer again to the professional motion picture. We are all familiar with the remarkable characterizations of Chaney. Never in real life have we seen faces which resemble his make-up, yet he succeeds in giving the exact impression which is desired. He uses an artistic rather than literal make-up! In one of his famous characterizations, the "Phantom of the Opera" there was nothing particularly terrible in any single feature of his make-up. It was unpleasant of course, but an exactly similar visage upon a living person would inspire only pity in our minds. Whence came the appalling aversion inspired by this make-up? The shading on the face was angular, the face rough-hewn, the motion upon the stage of a staccato character. The entire impersonation was designed, not to represent a human individuality, but rather to create an atmosphere of evil. Retaining costume and make-up, that is the grease-paint design upon the face and the other artifices employed, but changing the motions would have given an entirely different character to the Phantom. Thus, perhaps unconsciously, perhaps consciously, the world has acknowledged Chaney to be an artist. The fact is unmistakable. His artistry would have been just as great had he elected to remain in "straight" rather than "character" roles. He does not portray an individual, but a personification of an emotion!

With these few hints, those of you who feel the urge of creation may proceed with a new and better form of motion picture drama.

CHAPTER THIRTEEN

Amateur Films

The camera is the tool in the hands of the artist. This is true without regard to the nature of the films made. The camera as a mechanism remains mechanical, just as the brush and canvas of the artist are simple mechanical contrivances. Furthermore, the manipulation of the camera constitutes the technique of motion picture art. Again this is more or less standardized. Technique is scientific to the extent that definite rules concerning it may be laid down. But, the final product, the projected image upon the screen, is the result of something far more intangible, far more subtle and of infinitely greater value than these mechanistic details. This something is the artistry of the producer! It involves creation, and creation comes only with purposeful production!

If we film a pendulum swinging, that is nothing beyond photography of motion such as might be used for investigation regarding the mechanism of the illusion of motion photography, but it is not production. However, mark this, the same shot might become a vital part of a production if inserted in the proper place in a film where it would convey a definite impression to the spectator!

The individual, component scenes of a motion picture are rarely intelligible. The deftness shown in weaving the scenes together marks the difference between the artist director and his "rule-of-thumb" brother. So production consists not of recording scenes upon celluloid, but in so arranging these records that the spectator receives a definite impression which is not projected and which is usually of such nature that it is not subject to physical representation! This is the art of direction. This is in turn combined with the graphic art in which each move-

ment of each subject is made in accordance with the laws of harmonious motion. This is the art of motion photography. This harmony is in turn attuned to the spirit of the scene portrayed. Just as we have intense emotion brought on in music by the introduction of resounding chords and clashing discords in opposition, so we can secure intense emotional effects by the opposition of the utmost heights of harmonious motion and harsh, "angular" motion.

As these two arts must be brought into harmony in order to achieve the sublimity of an artistic production and to escape the imminent danger of becoming ridiculous, it is essential that cameraman and director be one individual. This new conception of the motion picture art, which holds such promise to the amateur, will probably never become commercially successful until the cameraman and director are combined in one individual with an assistant to watch the motor driven camera.

With the director and cinematographer combined in one individual we have the entire *essential* personnel of a producing "company" for this individual may work with inanimate subjects.

Thus we see that production, no matter how simple, nor how ambitious does not necessarily need a company. One-man production has been repeatedly attempted, and repeatedly it has been unusually successful, both in professional and amateur motion photography. Any camera owner who wishes to spend just a little time and thought can turn his haphazard films into productions of interest. He can call to his aid as many assistants as he can interest or as many as he may want. Conversely he may work entirely alone, but this is incidental.

The one thing which is essential for successful production is the precedence of purpose over exposure.

It is quite excusable for the snap-shooter armed with his two dollar black box to go out and shoot the giraffe's legs and the hippo's ears at the zoo. We can excuse him when he lops off Mary's feet and gets the family domicile falling down a hill side. We only smile when he tries to "steal" shots of beautiful (?) girls upon the sidewalks,

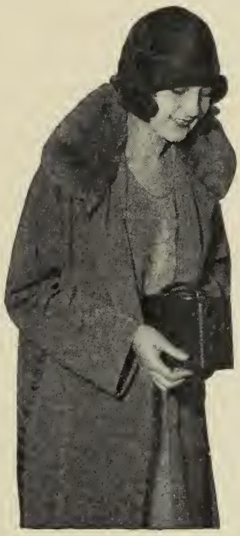
but we hope, at least, that amateur cinematography has risen slightly above that level. In the motion camera you have a wonderful instrument of marvelous precision. You wouldn't use a new sedan to haul away your ashes, then do not use a motion camera for aimless photography. Do not touch the release button of your camera until you know *what* you are going to shoot and *why* you are going to shoot it. When you know these two things you are well upon the way to production.

(*Courtesy Eastman Kodak Co.*)
The Ciné Kodak may be used at eye level by the use of the direct finder.

"Snap-shot" is a purely artificial word. It denotes just what it expresses, a "snap" exposure, one made on the spur of the moment with little or no preparation, and in contradistinction from the rapidly made but expert exposure, it carries with it the insinuation that the maker is ignorant of even the most elementary theory of photography. How different is the case of the alert, expert photographer, who will swing his camera into action, and often secure a photograph in less time than is taken by the amateur, but in the latter case the photographer has used the proper diaphragm, has mentally analyzed his sub-

ject and has made an exposure which will emphasize the points of greatest interest in his subject.

Break Shots.—It often happens that the cinematographer, especially when he is travelling, is confronted with an unexpected subject which is of such nature that an immediate exposure is necessary if the film is to be secured at all. This type of subject we call a "break," a term borrowed from newsreel work. In the "snap-shot" we have a shot made blindly, with no attention to lightfall, stop, or character of subject. In the case of the "break



(*Courtesy Eastman Kodak Co.*)

The Ciné Kodak is provided with a brilliant reflecting finder which makes possible its use at waist level.

shot" we have a shot quickly made, yet with properly adjusted lens, with due attention paid to the nature and fall of light and in fact to every phase of the work which will aid in adding quality to the print. Never forget that the end result is the positive film.

Film Classification.—Amateur films may be divided into several groups. Some of these groups overlap, and one film may properly belong to two or three classes simultaneously, but such an arbitrary division will give us a basis for discussion. These are:

The Break Shot—This has been fully discussed. It is a shot of an unexpected subject and necessitates the utmost precision in the correlation of mental and physical action.

The Planned Shot—In this case we have a shot which we have studied and planned in a certain manner. We are familiar with the light, the subject, the proper exposure to be given, the probable duration of the shot and the general nature of the action involved during this time.

The Home Shot—In such cases we have all of our apparatus more or less near by and we do not have to use the same care in preparing for the exposure. The surroundings are familiar and we will no doubt, work more at ease than we otherwise would.

The Shot Abroad—This does not necessarily mean Europe! The shot abroad is any exposure made away from home, no matter whether it is made in a neighbor's back yard or in Timbuctoo. In such work, care must be taken to see that all necessary items of equipment are included. It is somewhat embarrassing to find, when you are ready to shoot, that you have nothing at hand in the way of optical equipment except a telephoto lens. And it is even more exasperating to find that you have no film. Check up the equipment carefully. If you can do so secure a carrying case in which there is a definite place for each item of this equipment and see that each item is in its place before starting out.

Interior Shots—Interior shots are the most valuable of all, and in some cases the most difficult to make. To avoid trouble and insure success the cinematographer must supply himself with either a very fast lens or a battery of arc lights or both.

Exterior Shot—Only the opposite of the above.

Straight Record—In which the film is nothing but a record of some subject over which the cameraman has no control whatever. This will form the majority of shots made by travellers.

Controlled Shots—This includes the amateur playlets, family record scenes and others in which the actors are more or less subject to the direction of the cameraman.

Manipulated Shots—In which some trickery is resorted to.

Thus we see that the majority of travel shots will be straight, exterior, break shots made abroad while the amateur photo-play will be usually interior, planned, controlled and at times manipulated shots. Practically every shot which is made will fall into one or more of the foregoing groups.

As the success of the break shot depends upon the extent to which the technique of cinematography has been mastered, there is but little to say regarding it in this place. Part One of this book is the part which is of interest to the man making a break shot. On the other hand, cinematographic technique is really of minor importance in the planned shot as here we have the cinematic technique supplanting the cinematographic. The emotional characteristic supplants photography as the essential quality.

CHAPTER FOURTEEN

RECORD FILMS

Record films comprise, perhaps, the majority of all films produced by the amateurs of the world. In the United States, which is after all the country of the movies, there is a considerable inclination toward the "Little Cinema" movement, but even here, the recorders will outclass the photo-dramatists. The artist, the cinematographic artist as opposed to the cinematic artist, is so rare that he must be considered as an individual and not as a representative member of a typical class.

The record film presents to us a reproduction of "Things as they were." It is a true reproduction of some scene or event which at one time actually existed. As such it has historical value. Whether this value be personal, regional or national depends upon the nature of the subject, but as it is recognized that a film of little Jimmie is more highly prized by his parents than would be a film of the visit of the Prince of Wales, we must not allow our prejudices to force us to undervalue the personal history as reproduced and recorded on film.

The point of most importance to be watched in making the record is that of photographic technique. When this is done there is little else that can be done to add to the chances of success.

If the subject is one which is repeated at frequent intervals and one which may be made at any time, the best plan is to study it carefully at different hours and under different light conditions. In this way we can make an intelligent choice of time. This will do much toward making a success of the film. If such conditions do not exist, the shot must be made as best it can, choosing point of view and lightfall as far as may be possible.

(*Courtesy Amateur Movie Makers*)

Outdoor sports furnish some of the most attractive subjects for the amateur ciné camera.

As the record shots comprise the greater percentage of travel, picnic, vacation and similar shots, this type of work will be discussed here.

Before leaving home the camera and all accessories should be thoroughly examined and conditioned for the work in hand. The camera itself should be carefully brushed out with a soft, camel's hair brush. After this is done, look carefully to see that no hairs from the brush have remained caught in the mechanism. The details of the film are magnified 100 diameters or more so that a very small bit of dust or foreign matter will cause a marked spot upon the screen. Also, grit, dust and bits of film may get jammed in the gate and scratch the film as it is being exposed. A dirty camera is inexcusable, and the first thing to be done before starting out to make pictures, is to thoroughly cleanse the camera.

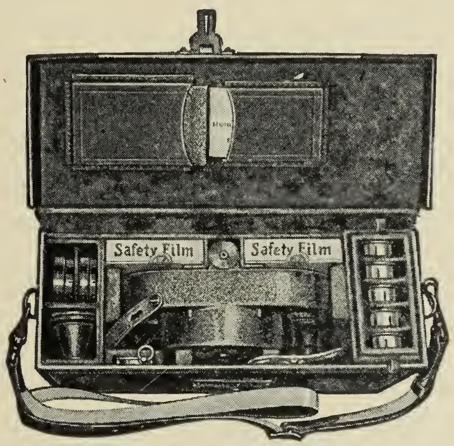
The motion camera is essentially a mechanical device, and like all mechanical devices it will not properly operate unless all rubbing surfaces are protected from each other by a thin layer of oil. Still cameras, and particularly their shutters should never be oiled, but the motion camera must be properly oiled if it is going to give continuous satisfactory service. In oiling the camera the manufacturers directions should be followed explicitly. The oil holes provided are marked, either upon the camera itself or in some manual or direction card.

The oil to be used should be the finest watch oil. The usual heavy bodied lubricating oils are too heavy for the delicate mechanism, while the various very light "patent" oils are worthless as they have no lubricating body and are absolutely inefficient for motion picture camera work. At times, for some reason or other the oil in a motion picture camera will become heavy and gummy. This may be due to evaporation of a low grade oil, leaving behind a certain resinous deposit or it may be due to the accumulation of dust and grit by the oil. This deposit must be removed. It is hardly advisable to scrape it off with any metal tool for this will mar the mechanism. A better way is to secure a large water color "wash" brush and a bottle of grease solvent such as "Carbona." The solvent is applied to the

deposit with the large brush, taking care not to allow an excess of the solvent to fall into the mechanism proper. By this means all old oil may be removed from the mechanism. After this the parts are thoroughly dried by wiping with a soft, clean cloth and then subjecting the mechanism to a draft of warm air such as is supplied by one of the inexpensive hair driers. When this is done, fresh oil is applied.

An excessive amount of oil should always be avoided, for oil spots upon the film will inevitably result in a spotted positive whether the reversal or two film process is used.

When the camera is thoroughly cleaned and has been tried out to see if it is functioning properly, attention is turned to the accessories. When possible a special case should be purchased or constructed which will provide a place for the camera and for all accessories. Such a case may be easily made of plywood or similar material. Inside the lid should be placed a list of the accessories which should be in the case. For the average traveller's use this list will contain:



(Courtesy Bell & Howell)

A case which will contain the camera and all of its accessories will often prove to be of great value. The Filmo case shown here has proven popular.

Camera, winding key, reflecting focusser, filter holder, light yellow filter, compact folding tripod, ball head for tripod, Dremophot meter, scene record, outside iris, f 1.5

lens, 2 inch lens, 4 inch lens, sliding base, mask box and 12 rolls of film. In a small box inside the case will be carried a tool kit consisting of jeweller's hammer, 3 small punches, round nose pliers, square nose pliers, pin vise, assorted screwdrivers, 2 camel's hair brushes ½ inch and ¼ inch, scissors, and a small roll of wire with one of adhesive tape. A changing bag will often prove useful on extended journeys in case the film buckles or otherwise becomes jammed after some very valuable shots have been made upon a roll of film.

This is a complete outfit such as would be carried on a transcontinental tour or a trip abroad. For the shorter vacation trip, the extra lenses may be dispensed with although the f 1.5 and the 6 inch will always come in handy. Also, the reflex focussing device is practically indispensable. This may also be said of the Dremophot, so in this case we have a far more compact outfit with which to work, yet one which will adequately serve our purposes.

Before making exposures in unfamiliar localities, especially in foreign countries it is well to determine whether or not photography is forbidden in that place. There are many places where photography is absolutely forbidden, and such places are not always designated by public warnings such as signboards. The position of a cinematographer caught making film in a forbidden spot in a foreign country is pitiable, for, especially in Europe, the constant fear of espionage has become a mania and concerning this "crime" many Europeans are as unreasonable as other monomaniacs. There will be little of this spirit encountered in English speaking countries. However, even in our own country there are certain locations such as some parks, museums, art galleries, military and naval reservations and so forth where photography is prohibited or only permitted under a written permission. The reasons are various and usually well founded. In case application for permission is made it will usually be granted. Naturally there are some parts of military and naval reservations where this work is absolutely prohibited.

In addition to these difficulties, there are many people who as individuals and races object to having their photo-

graphs made. These objections are principally religious and superstitious. This objection will be encountered in many different parts of the world, but more particularly among the primitive Christian races and among practically all semi-civilized races who have learned what the camera is. Curiously enough there is little such objection among the more truly savage races.

To particularize, there are communities in Holland where the photographer risks severe personal chastisement if he is discovered making photographs of the inhabitants who believe that if they are photographed, even unconsciously, that they are party to a sin against the tenets of their religion. Among many Oriental peoples there is a belief that the camera lens is the original "evil eye." Among our own Indians many believe that the possessor of a photograph may bring death to the individual whose image is upon the photograph by merely destroying the print. These are not half recognized beliefs as are our pet superstitions, but absolute convictions, and as such the punishment meted out to the photographer by these peoples is often severe indeed.

Stealing Shots.—Naturally these facts make the films in question the more valuable. The still photographer will often secure a snap and get away with it, but the cinematographer who has to secure an exposure which lasts for an appreciable length of time has a different problem to face. There are three ways of securing this type of film. The first, most obvious and least successful is to sling the camera at hip level and to "shoot blindly" from this position. However, in this case the lens is obviously pointed at the subject and almost inevitably the whir of the mechanism will attract his attention, and then the holiday starts.

The next best method to use in this work is the use of the six inch lens. It is often possible to secure a shot from a distance of seventy five or a hundred feet that would be impossible from a distance of twenty-five or thirty. These primitive peoples seem not to have learned that some of these "guns" are "long range" but even so, if the operator looks too closely at his subject or is too obvious in his

technique he may be seen and his film lost if no more serious effects occur.

The last and best method is the prismatic method. This is accomplished either by the use of the prismatic finder or the reflex focusser. In this case the operator stands with his side toward the subject and is evidently absorbed in the contemplation of a scene in front of him and disinterested in the subject above all else. There is a phase of aboriginal psychology which helps the cinematographer in such a case as this. These people are more or less childish and therefore curious—nor is this description limited to

(Courtesy Amateur Movie Makers)

Scenes like this make the travel film really worth while.

the members of the races which we call primitive, the same holds true of people in all stages and strata of society. These people will crane their necks to see what it is all about and be perfectly happy as long as the camera is not pointed at them individually. Thus if the cinematographer is a good actor, and asks those in front of him to move aside, even when this is unnecessary, and squint and gaze at the scene in front of him, and talk about it to his companions, if any, he can get away with everything short of murder and bring away a wonderful set of films.

There is some ethical question involved in such work, but when the objection is founded upon religious scruples or superstitious fear, no harm is done as long as the subject is unconscious of the fact that his likeness has been made. Therefore there is not the slightest ethical objection to such stealing, perhaps the only theft which may be whole-heartedly sustained by the most moral of people.

POOR LIGHT.—In travel work, there are often scenes, in fact entirely too many for the peace of mind of the amateur, which are just a bit too dimly lighted, many in interiors and many which occur upon dark days. There is one answer to this, do not start any extensive journey without your fast lens, and of these the most rapid is the Plasmat f 1.5, whose enormous aperture enables one to secure films in ordinary interiors without artificial light. Naturally under such conditions, and more particularly when working in a strange country where the relative visual and actinic powers of the light are unknown, the Cinophot will be used or the Dremophot. In this way properly exposed film is assured.

SCENIC PANORAMAS.—In preparing travel films as such, for future projection at home, there is a definite plan to be followed. The scene is introduced as a whole and then details are shown when desirable. In most cases the first view will be panoramic. This is necessitated by the fact that the lateral dimension of any scene greatly exceeds the vertical, and as we wish to practically fill the frame vertically, we must panoram to show the whole scene. Now unless a panorama is properly made it is a distressing thing to view and then the film is better off without it. The panorama must be made *slowly,* the horizontal axis of the scene must remain constant, and the rate of progress must be uniform. These conditions are practically impossible to meet with the hand held camera, and the friction tripod is not always fully satisfactory. A geared tripod will secure this effect, but the best way of all is by use of the Hayden Automatic panoram head. This is a geared head driven by the camera motor. If the tripod is carefully levelled, the panorama will be slow, uniform and in a perfect lateral line.

Landscapes.—As many of the films made during travelling are purely landscape, a new problem is introduced. At best about one-third of the film will be sky. The usual amateur sky is pure white and this robs the scene of any possibility of beauty. Clouds are incidental, but most important adjuncts to pictorial representation of a landscape. Even the cloudless sky has a definite tone which should be shown. The traveller's kit will contain an assortment of filters, two yellow, one light and one medium and it will also contain a cemented, graduated sky filter. These will practically insure the proper sky tone in the picture while the exposure meter will indicate the necessary compensation for the filter.

The mention of the landscape brings up another point. The motion picture is essentially a picture of *motion*. It is evident that motion must be included if the film is to be of the most satisfactory type. For this reason, a figure is usually introduced into the foreground of the scene. This figure should be appropriate, either one of the party or better yet a native of the country in costume. But whatever the figure, it must be apparently unconscious of the camera and posed as though regarding the scene. If there is a point of particular interest this figure may well indicate it by pointing. If this figure is well managed, it will add greatly to the value of the film.

Tropical Work.—Finally, if travelling in tropical countries, provide yourself with a number of tin film cans and a roll or so of adhesive tape. Place the fresh film in these cans and wrap the joint with tape, then when the film is removed from the camera place them in this can and retape. If the climate is warm and humid, it is well to carry a small quantity of calcium chloride, and a large tin box about six or eight inches square. The chloride is heated until powder dry and placed in the box. The film is then placed in the box with the lid of the film can open. The lid of the box is closed and the film allowed to remain for an hour. The box is then opened and the film can immediately closed and taped. This will keep the films in better condition than would be otherwise possible.

The points to be observed in making travel films may

be well adapted to making week-end and vacation films. The reflex device will often enable you to secure films of friends without their knowledge, while the introduction of the slow motion and reverse will enable you to secure films which will both surprise and delight the subjects when it is projected.

Needless to say landscapes demand the same treatment whether an hour's drive from home or on the opposite side of the world. In fact vacation and holiday filming provide excellent practice for the longer journey.

CHAPTER FIFTEEN

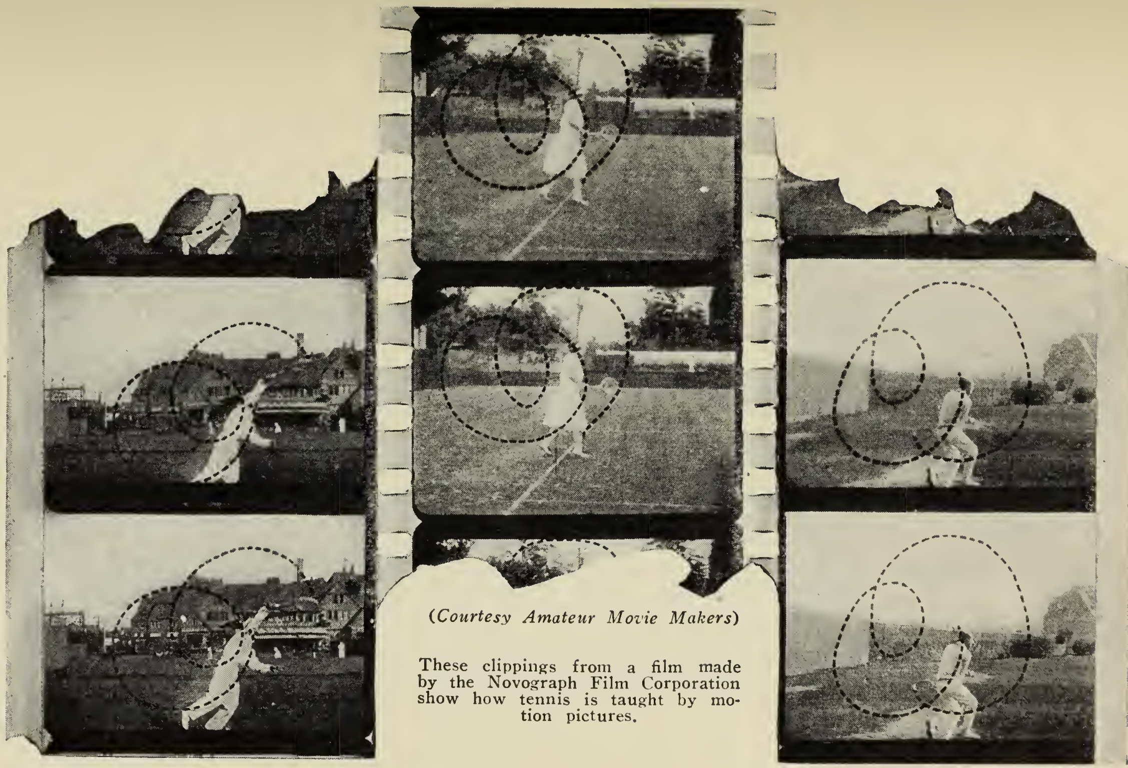
ANALYTIC AND INSTRUCTION RECORD WORK

The record film may be one of such an infinite variety of subjects that it is difficult to choose those which should be mentioned and those which should not. While the substandard film is of great and undeniable value in many kinds of business and professional activities, such uses of the substandard film are hardly appropriate for inclusion in the present volume. We are now solely concerned with the motion picture camera as a companion in our moments of relaxation and pleasure. Of course, most of the principles set forth in this book can and should be applied to any form of substandard motion photography, but we cannot consider the actual details of commercial work here.

Sports.—Few of us are primarily cinematographers, although the writer must plead guilty to the charge. Most owners of motion pictures are devoted to some particular sport or hobby and many of them have been introduced to the pleasure of motion photography by this sport. There is no question but what the motion camera is of great value to any sportsman, either as a means of recording the pleasures attendant upon such sport, or as a means of criticism and instruction.

We may arbitrarily divide some of the major sports into these classes: The organized and exhibition sports such as football, basketball, baseball and polo. The individual sports such as archery, fencing, golf, tennis, swimming and dancing and field sports such as hunting, fishing and shooting. Other sports may be placed in one or another of the three classes.

The exhibition sports necessitate two phases of activity, the training or preparation and the culmination of this training period in the actual occurrence. In work of



(*Courtesy Amateur Movie Makers*)

These clippings from a film made by the Novograph Film Corporation show how tennis is taught by motion pictures.

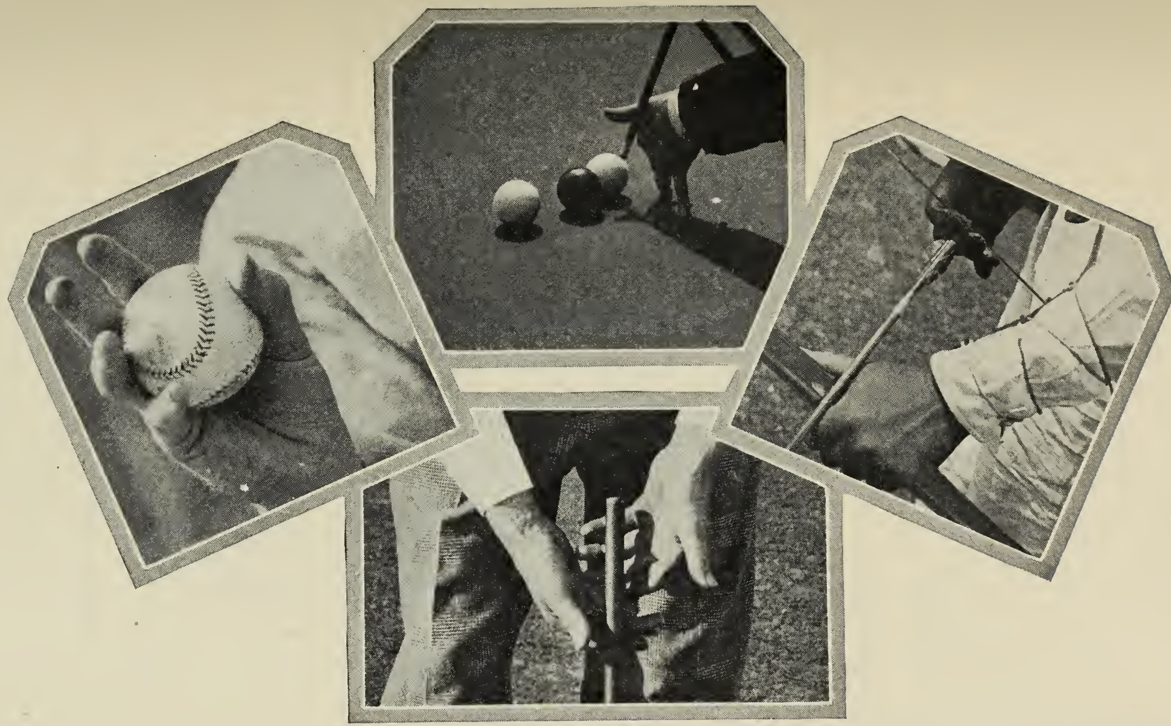
this kind, the motion camera is valuable in many ways. During the period of training the slow motion film will reveal the faults and mistakes of the individual players and by showing these players their errors in detail they are enabled to overcome such mistakes in the shortest possible time. This method is made use of in several of our larger Universities. Later during the actual game, the motion camera gives us a valuable record of the event. At this time, too, a positive record may be made which will absolutely eliminate any controversy concerning certain plays, after the game is over. In this way the films have proven very valuable in connection with the recent championship boxing bouts. The final use of the camera in such sports is for securing an analysis of the tactics of the opposing team and the individual players of such a team.

In the individual sports, that is the sports which require specific training, and which require physical activity on the part of the individual himself, the motion camera is of even greater value than in the case of the exhibition sports.

Slow Moticn in Sports.—Here we have a physical activity which is satisfactory only in direct relation to the perfection attained in the coordination of brain and muscle. In fencing, golf and tennis the actual motion is too rapid for the eye to really perceive it. Here we find the slow motion camera to be of great help. In the beginning, slow motion films are made of your action, engaged in these sports. Later another set is made and compared with the first set. This provides one with a critical analysis of the motions, but does not directly indicate the necessary correction. The next step is to make a set of slow motion films showing some expert in action. This provides a "check list" to accompany your own films. Now after looking at yourself in slow motion, look at the film of the professional and note the places where the discrepancies appear.

So efficient has this plan proven that a series of golf films have been placed upon the market for the sole purpose of teaching others to play, and to aid golfers to improve their form.

Many skilled trades and most athletic sports depend



(*Courtesy Amateur Movie Makers*)

These stills from Pathe films illustrate the use of the motion picture film in demonstrating sports which require perfect coordination of eye, brain and muscle.

upon extremely rapid, exactly coordinated action. This is something which must be learned slowly for as the eye is unable to follow the details of the action, only repeated trial and error will bring proficiency. But when the slow motion camera presents the analysis of the action to the eye, one can become proficient in these actions almost immediately. The use of such motion analysis films for teaching purposes has proven surprisingly successful.

Let us consider the aesthetic dancer. Most of her movements cannot be slowed down for purposes of demonstration because they are rendered possible only by reason of the speed which overcomes gravity. The dancing instructor can only repeat the motion time after time with the student vaguely trying to imitate her. In this case the slow motion camera makes each individual muscular contraction plainly apparent, and the student finds his task far easier than ever before. Not only is this true, but the same method of analysis will enable the dancer, herself, to recognize and eliminate the subtle points of poor technique which have crept in to mar her work.

In fencing the slow motion camera is a boon indeed. The greatest charm of fencing is the flash and flicker of the blade, and even the master loses his lightness and grace of movement when he tries to make a thrust slowly in order to show the student the proper method.

In fact all such sports and activities may be made doubly interesting by the judicious use of the motion picture camera. But even so, this does not complete the roster of sports which lend themselves to motion photography.

The field sports, fishing, hunting, shooting, riding, racing—all of them bring repeated pleasure by being projected time after time. It is true that in these cases the film is rarely more than a record of the event itself, but this is sufficient. In all athletics and most artificial sport there is a sense of health-building, or duty and of physical exertion, a sense of the material and of the gross. Of all the artificial sports perhaps only fencing and dancing are free of this shadow. But the field sports! What a difference there is! There mankind knows the pure unadulterated peace of perfect content. There is no thought of

struggle, of victor and vanquished, nothing but a thoroughly enjoyable period of time, which is so near perfection that the mere reproduction of it upon the screen later on will bring back a ghost of that joy to lighten the workaday world. There is a magic in the field which exists nowhere else, and which the motion camera can capture in full. The films made by the sportsmen in the field will be enjoyed by everyone who is fortunate enough to see them, and they will revive the most pleasant of memories. There is little reason for the film afield to be more than straight record.

(Courtesy Eastman Kodak Co.)

Ciné Kodak Model A equipped with telephoto lens. This equipment finds great favor with hunters who are using it instead of their more destructive guns.

THE HUNT.— In making hunt pictures, the best procedure is to find a location where the approach of the hunt will have an appropriate setting or "framing." When the hunt can be heard approaching, especially if the horses are to emerge from a wood, crank a few seconds on the empty scene, for the initial appearance of the horses

breaking from the wood makes a most impressive shot. It is better to set the camera so that the axis cuts the path of the hunt at a fairly sharp angle and to make the entire shot from this setting than it is to try to panoram on the hunt. If the horses appear in the middle distance and leave the frame at one side or the other of the foreground, the effect of the impetuous spirit of the hunt is carried into the film while a panoramed shot is merely a shot of a group of horses and riders galloping by.

The Field.—The bird hunter forms a different problem. Here we have a series of scenes which are effective only when taken from various angles, and we have conditions which are more amenable to the circumstances encountered in still photography than in motion work. There is usually only a short period when the scene may be presented most effectively. In the course of the hunt, unless there is a background which is attractive in itself, the scene is merely that of dogs dashing about and the hunter in his nondescript clothing pulling at a disreputable pipe as he trudges along. But let the dog scent a bird. Then the scene changes instantly, in fact usually so quickly that the full beauty is lost before the cinematographer can get into action. The dog stops and "freezes," the front leg lifts and the animal stands as though posing for a sculptor. The man's whole attitude changes, he becomes alert and watchful, his gun held at "ready." Then comes a soft whirr of wings, a jerk of the gun, a crashing report and it is all over, with possibly less than five seconds of real action.

Fishing.—Likewise, in the fishing picture, either the most beautiful part of the film is lost or a lot of film is wasted. The fisherman swings his rod and casts his minnow into the edge of a shadowy pool. This alone will make a beautiful shot. But when a ten or twelve pound Southern Bass hits the bait a smashing blow and the fight begins, that is the time which brings to the cinematographer the chance of a lifetime. Such a film is almost impossible to secure properly and when it has been secured the amateur has a film really worth keeping.

Perhaps the field sports should not include races. Racing is a distinct form of sport and practically the same pro-

cedure will be followed in any race. As far as motion pictures are concerned the horses (running) and motorboats provide the best subjects. Automobile races look too much like a circus, and even cross country automobile racing is not very picturesque at the start and finish, and those are two events which must be secured in connection with any race film. A comparison of the two big classics at Indianapolis and Louisville will show the great difference in motion picture possibilities between the horses and the automobiles.

So throughout the sequence of sporting records we find that our films are straight records of the event itself, made for purposes of future entertainment; slow motion analytical records made for the express purpose of providing a final answer to any question which may arise after the event has been completed; either normal or slow motion analytical records of a competitor made for the purpose of analysing and combating his tactics and the slow motion record made for the purpose of criticising and improving one's own errors.

There are of course, times when the films made exceed the limits laid down here. This is to be expected, for the classification used herein is arbitrary and used for convenience rather than as a strict, scientific classification. For example the yachtsman will use his camera not only for race records, but he will use it to supplement his log during cruises. This of course brings his work over the line of sports films into the field of travel films, but in this particular case the films will all have a touch of both characteristics.

In modern days it is quite usual for the college and university teams to have a motion picture camera taken along with the team to every game. The films of the event then go into the archives of the school and at the same time individual films are made available for the members of the teams and of the student body.

Exploration.—The greatest sporting event of recent years, Lindberg's flight, was recorded upon film, and most of you know how popular the prints were. Such events, exploring voyages, big game hunting, all events which,

while really of a travel nature, have the element of daring and exploration may properly be classed with the sporting film, as they differ so widely from the usual travel film as made by the casual tourist. Even the amateur ethnologist can hardly class his work with the sports because, while he does run a certain amount of risk, his work is undertaken in a scientific rather than daring spirit.

Making the Exposure.—As for details of operation, these are about the same as in other cases. During the big game, when the spectator is somewhat removed from the scene of action the long focus lens will prove invaluable. The difference between the field embraced by the one inch and that embraced by the six inch lens is really remarkable. In many other sporting events, of whatever nature, the cameraman is often forced to take up a position somewhat removed from the scene of action, and it may be regarded as axiomatic that for all sports pictures, with the exception of the posed actions for analytical purposes, a lens of not less than three inches focal length should be used. This gives us a three to four lens range, that is; three inch, three and three-quarter inch; four inch and six inch.

In preparing for such work, and when using such long focus lenses, the range finder is invaluable also. By checking the field of action, the cinematographer can locate any portion of the possible field of action which will not be properly covered by his lens set at infinity and can, when necessary, establish a focal point for use in emergency.

When possible, secure a position where the sun will fall obliquely over your own shoulder upon the subject. This may not always be easy, but any trouble will be amply repaid, and finally make sure of the exposure, for there are often extraneous circumstances surrounding the field of action which will have a decided effect upon the exposure.

CHAPTER SIXTEEN

NATURE STUDY AND SCIENTIFIC FILMS

One of the surprising things about amateur cinematography is the number of scientists, travellers, explorers, naturalists and students who are numbered among its devotees. Until recently the substandard camera has been of but questionable value to this class of worker, but due to certain recent developments, the substandard motion picture camera is now available for practically every known kind of scientific work.

The making of travel and exploration films is little different from the usual travel practice except in those cases where unusual conditions prevail. Where such conditions are encountered it must be evident that the cinematographer, whether amateur or professional will have to formulate his own procedure. Rather than to try to set forth individual instructions covering every such condition possible, let us at once pass to the consideration of the various classes of subjects which may be encountered.

NATURAL HISTORY.—One of the most widely used purposes of the motion picture in science is its use in connection with natural history, and kindred branches of research. In fact, in the case of mammals particularly, the realm of the scientist and of the sportsman overlap, but while the sportsman wants films of the sport type, the scientist will want films which depict the animal in its most natural poses and surroundings. Of course when the animal is of the nocturnal variety, a source of light must be used and this will make impossible a truly natural picture, but many animals exhibit only curiosity in the presence of a blinding glare and for this reason magnesium flares often serve both to illuminate the scene and to distract the attention of the animal from the hiding place of the camera and its operator.

The filming of fish and other marine life in clear pools offers a very attractive field of amateur cinematography.

For such work a supply of magnesium flares should be carried as well as one or two telescopic stands for supporting these flares. They must be so placed that they may be ignited without causing a disturbance. The flare must be lighted at the time the exposure is desired because they

(*Courtesy Amateur Movie Makers*)
The sportsman will find it possible to secure many scenes like this one caught by Walter D. Kerst, one of America's foremost amateur cinematographers.

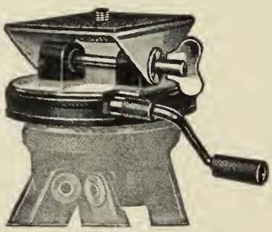
burn only for a comparatively short time, thirty seconds, one minute or two minutes according to the size used. This is beyond doubt the finest, fully portable, light available for motion picture work where electric current is not available.

In cases where such arrangements can be made, the camera should be set in a place, supported by means of a sturdy tripod, and carefully focussed upon a drinking hole,

burrow exit or other point where the animal may be expected to stop. With a little ingenuity a wire release may be fitted to most cameras and this extended to thirty feet or multiples thereof by means of the familiar wire release extension and couplings.

Tie a wad of oil-soaked waste about the fuse of the flare, and over this spread a small amount of gunpowder or flash powder. In the powder bury the ends of two wires, one grounded to the stand, the other running to the high tension pole of an old fashioned auto spark coil which is carried in a small case with the necessary dry cells. Pressure upon a spring switch will ignite the powder, this will ignite the waste and this in turn will set fire to the flare wick. The structure may be so built that an appreciable interval will result between the flash of the powder and the ignition of the flare.

From a point of concealment the area illuminated is watched. If the ignition of the flare does not scare the wild actor, the release is pushed in and held for the necessary time. It is true that this involves patience and many discouragements, but one film will amply repay a hundred trials.



(Courtesy Bell & Howell)

A small tripod head for amateur cameras which operates in a manner similar to the professional heads is quite useful. The one shown here is recommended for use with the Filmo.

Remote Camera Control.—Daylight film hunting is a far different proposition. Here the camera may be mounted upon a strong "tree" support, a device which may be attached to any convenient tree trunk or similar support. It is hidden behind a "blind" made of a twig or two cut from a bush and tacked in place on the tree trunk. Then from a remote blind the camera may be operated with the wire release as has been explained. For the operator the grass

suits used in duck hunting will prove very serviceable. This method is used when the camera may be focussed upon a predetermined spot.

When the action may be expected to take place in any one of a number of nearby spots, the only satisfactory recourse is the telephoto lens. Reference to the table in the Appendix will show that the field of the six inch lens at a distance of 500 feet measures 32 feet in width by about 24 in height. This is not at all too large for the inclusion of the larger animals. However in most cases the hunter may approach to within one hundred yards by using care. At this distance the field will be reduced to 14 x 19 feet. In this case we will get an image of an elk, let us say, which will fill the frame to the fullest extent compatible with good composition while the same lens used upon an ordinary camera would give us a direct print in which the animal would be about one-fifth of an inch, or less, in height. In this the tremendous advantage of the motion camera is exemplified, for by using the longer focus lenses an image size is secured which is out of all proportion to the usual relationship existing between the screen image and the hand held image. The screen shows the appearance which the eye would see at approximately fifty feet.

Bird Photography.—In the case of bird work the telephoto lens is an absolute necessity. It is usually difficult to approach a wild bird closer than twenty-five feet, and at this distance, even when using a six inch lens, the included field will measure 1.4 x 1.9 feet. Using the ordinary 30 x 40 screen this will give us an enlargement slightly in excess of 2½ times life size which is about as small as can be satisfactorily used in bird work. In this work the Telestar lens with a focal length of 9¼ inches will be of even greater value than the six inch lens.

In cases where there is plenty of light there is opportunity for a most fascinating field of cinematography. We have seen that the usual six inch lens as employed in motion photography has a speed of f 4.5. This is not due to any inferiority of the larger apertures, but because a lens of this focal length and of higher aperture would have a prohibitive weight.

It is often possible to find nests with young birds in them so situated that our meter will indicate an aperture of f 8 or f 11. Assuming that such a nest is discovered and the meter reading is f 8, we may safely set the diaphragm at f 4.5 and proceed to make slow motion film of the mother bird alighting upon a branch near the nest and feeding the youngsters. There are few films which will rival this in beauty and in interest.

This brings up another subject, one which will not be attempted by many of my readers, but one which is unrivalled in intense interest and to the student of abstract motion a truly beautiful subject. This subject is a serpent striking at its prey. I trust that an explanation of this is not due my naturalist readers, but for the casual reader may the writer digress a moment? From his own experience he can say that the loathing felt toward the serpent tribe may be quickly and easily overcome and that when this is accomplished there are few wild creatures more fascinating. With the exception of the very few poisonous snakes, there is no living creature more harmless than the serpent, regardless of the vicious attitude displayed in its attempts at self defence. Even the much dreaded "Spreading viper" (American) is capable of inflicting less harm than a two weeks old kitten. Serpents are the most easily tamed of all wild creatures although rarely becoming truly domesticated. A snake, such as the large Indigo Snake of the Southeast, when it becomes accustomed to being handled will provide material for several reels of film.

Snake Photography.—Work with snakes involves two distinct fields. Work with poisonous snakes should by all means be left to the experienced herpetologist who knows and respects the danger of the work. Such work should be done with a lens of from four to six inch focus, allowing a respectful distance to be maintained between reptile and camera. Work with the harmless varieties may be done with any suitable lens.

Slow Motion.—Slow motion work with such subjects offers unlimited opportunities and innumerable difficulties. Usually the serpent and its prey are confined together in a cage, but this is inimical to good photography. In

the open the prey must be restrained or it will immediately—and rapidly—leave the vicinity. The snake gives little if any warning of its strike. There is usually not sufficient notice to press the camera release. The film cannot be run continuously, for the magazine holds only about one minute of film at four times speed, and the snake may lie motionless for four or five minutes and then strike like lightning. As a rule it is easier to provoke the poisonous reptiles into striking than the non-poisonous varieties. However, the naturalist who makes a successful slow motion film of a huge diamond back rattler striking its prey will have a film decidedly worth while.

The other members of this family, toads, frogs, turtles, even the alligator present fewer difficulties, but almost as much interest. There are thousands of poses and activities among these creatures which are not at all familiar to the usual projector owner, and which should prove of great interest.

Marine and Submarine Work.—Venturing into the world of water we have the crabs and other creatures which inhabit the beaches, the fish and other marine life which will be found swarming in every pool. This work should prove to be unusually fascinating in the clear coral pools off the coast of Florida. Here exposures may be made from above the water, but care must be taken to avoid reflections which may not be immediately apparent to the eye. In addition the panchromatic stock should be used with a filter, as we have a tremendous reflection of invisible ultra-violet rays from the surface of the water. This gives rise to danger of haze-fog, and the visual image is also rendered with a brilliance out of all proportion to the photographic or actinic power of the light *reflected from our subjects.* In this work the meter reading should be doubled or even trebled even after taking into account the compensation for film and filter. Fortunately the glass of our lenses admit only a small portion of the lower waves of the ultra violet in any case, otherwise such work would be almost impossible. With a quartz lens a photograph will often be obtained under such circumstances which shows a silvery water surface, fully

opaque, when the eye saw water of such transparency that it was almost invisible.

If you care for comic films, set the camera up on the beach some fifteen feet distant from a crab's hole. Within your field a foot wide and nine inches high, using the six inch lens, you may very probably see enacted a comedy which will provide endless hours of amusement after a slap stick has lost all of its mirth provoking power.

And now, before leaving this subject, let the writer confess one of his greatest ambitions. Some years ago he had the opportunity to photograph a huge sea turtle upon its nest. He hopes in time to make a full hundred foot film of a similar subject. If you, who read this, live where you have the opportunity to do this, and so choose, may success go with you, but the writer should greatly appreciate hearing of the feat.

Insect Photography.—Leaving this realm, we descend to that inhabited by the tiniest of visible creatures, the insects. Here we find that our former apparatus is almost worthless. What if we do photograph an ant's nest at a distance of eight feet. Our field is a full six inches wide and upon a four foot screen this gives us only eight times enlargement. This helps but it is all too small. But what if we approach until the nest is only two feet from the lens? Then our field is only about one by one and one-fourth inches. When we project this upon the screen which measures forty-eight inches wide we have an enlargement of somewhat more than thirty-eight diameters. Then when we advance until the ant city is only eighteen inches from our camera's eye, we find our field diminished to about 0.6 x 0.8 inches, giving us a screen enlargement of sixty diameters! Sad to relate, this is about our limit, but even so we find the lowly bronze laborer who in real life measures possibly one-fourth of an inch in length moving about in reel life (forgive me!) with the huge bulk of fifteen inches! In order to use the six inch lens at such a distance it is necessary to have a lens extension of nine inches. This is not provided with the usual lens of this focal length, but if we utilize the fullest extension of the focussing mount of the lens itself, and then back up the

mount with the reflex focussing device, which we should have to use anyway, we find that we have approximately the desired extension.

It may be safely said that the entomologist would find substandard ciné work practically impossible without the use of this invaluable accessory. With its aid we have opened to our eyes a world of infinite interest and beauty, a world which exists in our parks and in our back-yards. The long focus lens and the reflex focusser place upon our screen those beauties of nature which have heretofore been limited to the vision of the microscopist.

Time Condensation.—The lover of nature is not, however, limited to the animate world, although it is true that the animate world provides the easiest subjects for the cinematographer. The vegetable world, or at least the visible portion thereof, is limited to motion so restrained in speed that it is invisible. The only way in which this motion may be shown to us is by time condensation which has already been explained. Here we have the opportunity for a most impressive contrast! First let us show an army of ants working feverishly. We approach nearer and show in slow motion a small group of two or three laborers, their movements rendered ponderous by slow motion. Then let us cut to the tiny weed about which they clamber and show this lowly plant putting forth leaves and expanding before our eyes. By careful and painstaking work we may switch from this time condensation work at any time and jumping to slow motion show the ants working about this self same weedlet, ants whose presence has escaped record during the condensation due to their constant and rapid motion!

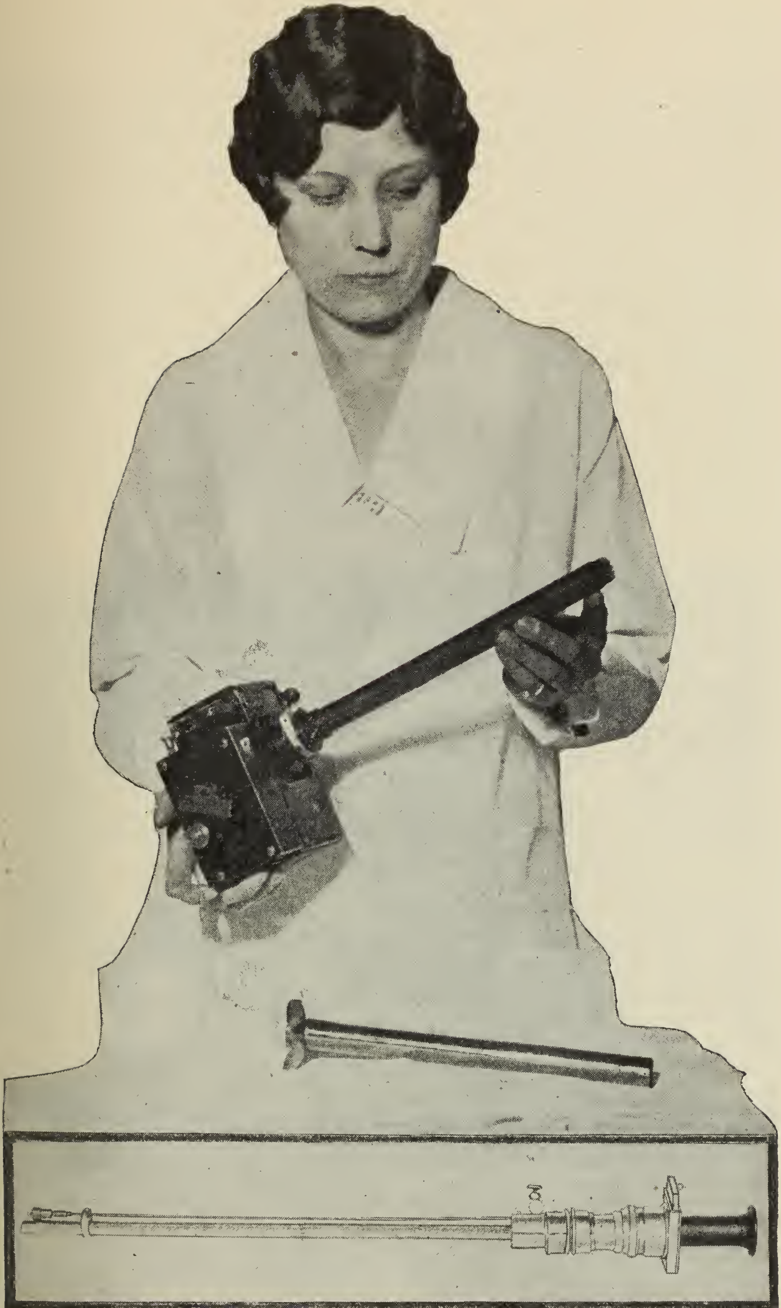
There is no conceivable device which has the power to bring to our attention the neglected and exquisite world about our feet to the degree possible with the motion picture camera. The still camera, the microscope, the microtelescope all must give way to this magic box which captures and places before our eyes the ceaseless activity of a world a yard-square, which has lain unseen beneath our eyes for years!

Cinemicrography.—The plant world offers new subjects

for many of the most delicate and beautiful forms of vegetation we have are carelessly brushed aside, lumped under that noisome word "Mould." But even our powerful six inch objective will not fully penetrate the mysteries of these plant forms so delicate that a breath will destroy thousands. Here we must have recourse to that ever useful instrument the compound microscope. It is well known that the microscope will not transmit actinic light in any great quantity, particularly when the light is split in a half silvered double prism. But if we use sufficient light with a cooling solution between the light source and the object we find that we have sufficient light to make microscopic exposures. This is particularly true when we consider that the usual subject has a motion so slow that half speed or even stop motion is necessary to show the proper appearance upon the screen. This is comparatively simple. However as we devour more and more of the magic toadstool and go into worlds smaller and smaller, we find that the rate of motion is increasing. Blood corpuscles in the web of a frog's foot bump and jostle each other in their journey, tiny particles in a solution dancing the age old dance of the Brownian movement put to shame the champion Charleston or Black Bottom dancer. These subjects require an illumination which will permit at least half speed, and as the effective aperture of the objective used on such tiny objects is smaller than the one used with the moulds and yeasts we have to increase the illumination in geometric proportion.

Finally when we get into the interesting world familiar to the bacteriologist we may, if we are careful, make a film showing a voracious leucocyte or white blood corpuscle, devouring a group of rapidly multiplying bacteria! Here again we have a comparatively slow motion and we may use stop motion at the rate of one exposure per second or even slower. The combination of microscope and motion camera is a treasure house in itself, for in your two hands you may hold material to keep you occupied for years without end.

But how are these two instruments to be joined? Through the agency of a little device known as the "Micro-



(*Courtesy Amateur Movie Makers*)

Surgeons have succeeded in making motion picture films of the interior of the stomach of living subjects by using the device shown in this illustration.

phot." This consists of a tube which slips into the tube of the standard microscope. It supports a split prism in a box. Most of the light is reflected by this prism through a second tube joined to the first at right angles. This leads to the camera where a suitable joint is provided. A smaller amount of light passes through the prism to the top of the tube where through the conventional ocular the microscopic field may be viewed. The apparatus is not one to be used carelessly, but the scientist will find that it serves its purposes admirably, and will prove of incalculable value to him. This device was designed as a companion to the Zeiss-Ikon Kinamo standard gauge motion picture camera, but it may be readily adapted to the usual substandard camera which has removable lenses.

(Courtesy Amateur Movie Makers)
Surgical operations may be faithfully recorded by means of the amateur movie camera.

So on through the world of science. We find the surgeon using the camera to record unusual operations, all danger of sepsis eliminated by using the long focus lens and operating from a distance, the archaeologist records

his finds as they lay in the enshrouding clay of centuries, the ethnologist records the habits and customs of strange people while his companion geologist makes use of the motion camera to secure continuous panoramas of strange formations.

The still camera has served the naturalist and scientist through years and it will remain a useful and loyal servant, yet its greatest achievements can hardly compare with the routive service given to science by the magic, moving ribbon of silvered celluloid.

CHAPTER SEVENTEEN

THE AMATEUR PRODUCTION COMPANY

We have briefly considered a few of the many phases of substandard motion picture photography, and now we come to that field which has been and always will be, perhaps, the focus of interest for the usual camera owner—the production of photo-plays. This is a very natural desire and one which should be encouraged rather than otherwise. Even if a photo-play of unusual merit is never produced the training in presenting the scenes of your films in logical sequence, properly titled, properly edited and properly acted will add incalculably to the value of your record shots.

Any motion picture should be carefully made. The setting, i.e., the "background" should be carefully selected, the properties used should be appropriate (as they usually are in record work), the costumes should not be incongruous, the actors should be letter perfect, the photography flawless. The developed film should be carefully edited and the titles should be composed, drawn and photographed with every attention to detail. All this is true of any film, but more particularly of the dramatic film. In the photo-play we have all of these elements with the added one of pantomime.

This is not intended to discourage you, but to impress upon you the fact that a fully satisfactory and successful result will be secured only if you are willing to put forth the effort and the care which would be given to any other creative work. Above all else, the actors must take the work seriously. Avoid the self-conscious "funny-man" who is driven, by a sense of inferiority, into being "the life of the party," burlesquing and clowning. Amateur production is not a joke, but it may be made the source of

infinite pleasure if undertaken in the proper spirit.

Naturally, dramatic production will usually necessitate the cooperation of a number of individuals. It fol-

(*Courtesy Amateur Movie Makers*)
An amateur club of Newark are starting out in the right way making high class photo dramas which will compare favorably with professional production.

lows that the first step will be to organize a club for the purpose of producing amateur films.

It can be understood that harmony in the work and congeniality of the members is of primary importance. If

you know of a group who habitually associate with one another, whose tastes are similar and who care for such work, that group is the logical basis upon which to found the club. Remember that this producing company is a group of people who expect to experiment more or less, with a new form of art. There can be no question of the routine and discipline which exist in the usual studio. Suggestions will be in order from any member of the group, but if anything is to be done, a responsible head must be appointed who shall have the power to decide any question which arises concerning technique. This head will naturally be the owner of the apparatus and the organizer of the club.

This group should be assembled and the purpose of the club explained carefully so that any who so wish may enter or remain outside. The fact must be emphasized that success will result only from enthusiasm, hard work, and unfailing interest. Each member of the group must be willing to study the work in order to arrive at an understanding of the technique involved. And each must be ready to give his fullest aid in every possible way. This being understood, there is no reason why the venture should not be a success. In case the individuals comprising this group are more ambitious than usual, there is no reason whatever why a certain, specific time should not be set aside for the experimental study of the aesthetics of motion.

When the club has been organized it would be advisable to secure affiliation with the Amateur Cinema League with headquarters in New York City. This is an organization for the advancement of amateur cinematography and is not a commercial organization in any sense.

The Studio.—For the production of the motion drama, some kind of studio will be necessary. In case operations have to be conducted along modest lines, an ordinary sized room will be sufficient for the stage, with two or three alcoves or closets for properties and sets. In fact, in the city a "studio apartment" and in smaller towns the upper story of a garage or a finished attic will serve admirably for this work.

The lighting equipment may be of the types of lamps already described, the double range lamps being very good for this work, but before connecting them a 100 to 125 ampere power line should be installed. This will take care of five or six of the 20 ampere lamps without any danger, and six of these lamps should be ample for all purposes. In addition to the usual arcs, one spot lamp and one or two hand lamps should be used. This will complete the lighting equipment. A twenty or thirty foot stage cable with jack box will be very convenient.

If there is a member of the group who understands architecture, even the simplest phases of that art, the studio can be transformed into a setting, various corners being treated in such a manner that anything from drawing room to dive can be represented. When painted sets are used, the foundation can be easily made of light wall board nailed to light wooden frames. Fantastic sets may be made with chalk upon newspaper stock and hung from the ceiling like theatrical drops. Futuristic properties may be made from wall board.

Properties.—Conventional properties may be borrowed from the homes of the members, while some stock pieces may be made to serve a variety of purposes. A plain table of the type which has two slab legs, one at each end may be a tavern table of the eighteenth century, the castle board in the fourteenth century, the chieftain's executive desk in the dawn of the Christian era, a corporation table in New Amsterdam or a table in a far western shack. By avoiding tell-tale identifying marks of period furniture, and using indeterminate styles, the larger pieces may be made to serve almost any purpose. In such cases the time is identified by smaller and more easily made properties such as costume, the best of all, and its accessories such as arms, jewels and so forth.

The usual amateur will no doubt turn to the conventional drama of modern times which requires nothing elaborate in the way of costumes, sets or properties. It should be remarked, however, that the production of "Period" dramas will be intensely interesting to the stu-

dent of history as well as being of considerable positive value.

The exact details of this work will of course be worked out by each group in a manner which will best suit its own requirements. The primary essentials are then: A place in which to work, a source of light and suitable background and accessories to lend the proper atmosphere to the scenes.

The Cast.—In the usual photo-drama there are two leads, male and female, two minor leads, male and female, a heavy or villain, the comedy either male, female or both and character actors, male and female. In many instances two or more of these roles will be played by the same individual, according to the demands of the scenario in hand.

There is nothing so very difficult in producing an amateur photo-play. The only thing necessary is a full understanding of the character, purpose and meaning of drama. There is entirely too much of the idea that dramas are completely artificial. Nothing could be farther from the truth than this. Anyone of ordinary intelligence can make creditable amateur photo-plays and with proper application and devotion to the work can soon make unusually good ones. Home plays are far more simple than the professional type, naturally the home technique is far simpler than the professional. You see, here is the whole story in a nut-shell——

Drama.—Life is drama. In fact Life is the one original drama which, due to the limitations of time and space can never be shown in its entirety upon any stage or screen, yet which has had the longest run of any production ever staged. Our drama, as we think of it, is built by eliminating from the original, all non-essential detail, leaving only the points of greatest interest and those which have a direct bearing upon the theme which we are trying to develop. These points are arranged in progressive succession, which might be represented as a flight of steps, in which each step leads to another of slightly more interest and a logical successor. This process leads us eventually to the point of greatest interest, the literary climax of our story. Then, instead of staying there or

coming back down, we virtually "toboggan" down to the level from which we started, and the shorter the period between the climax and the end of the film, the better the technique. This of course is only true when the story is completed and the return curve allowed to drop to its original level. When this is done, we have drama. Simple, isn't it? Just as simple—and as complex—as life.

Drama does not mean melodrama by any means. I once saw an almost perfect drama staged in a hencoop. Two baby chicks, one white and one black were quite chummy. Blackie found a worm and grabbed it; Whitey saw it too and also grabbed—the other end. Friendship became rivalry. They tugged and pulled and as usual gave little heed to the agony of the third party. The conflict raged, the favor being at times with one and at times with the other. Finally Blackie gave a vicious tug, Whitey lost his balance and opened his bill to squeak and Blackie walked off with his prize after having fought for it. Could any incident be more simple? With no intention of absurdity, such an incident has the elements of pure drama. Let us then remember that drama is not a high art understood only by the few, but it is rather a cross section lifted from life and polished up a bit so that it may be distinguished from the humdrum current which goes to make up the stream of life.

We have said that drama is not a fine art. This is true for drama which exists—but the creation of an imaginary drama is one of the highest of the arts, so the home movie maker will realize that any ventures into the realm of pure drama must be experimental. Let us call this, the usual dramatic art, creative dramatic art or merely creative drama. On the other hand it is quite simple to stand ready with the camera and shoot the more pleasing bits of any family incident, or even to recall past events and to re-enact them for the camera. Such a process we shall call selective dramatization. In this case we are making a film from incidents which are founded upon actual occurrences within our own experience. This is easy insofar as the production of a satisfactory home film is concerned, but with experience you will achieve results which are

better and better until you secure, almost unconsciously a knowledge of the drama which will enable you to start into creative dramatic work.

TECHNIQUE.—There is no motion photography in which elementary drama can be totally ignored. Even straight record work requires the correct chronological order; introduction, development of the "story" and the denouement. In order to make this easier, and to enable the beginner to secure the best possible results with his movie camera, this book has been written. It is not a record of the writer's experience alone, but rather that summing up of the experience of the leaders in motion photography which has been handed down to each of us in turn, lumped under the name, "Technique." Technique is not a complex mystery. Regard it as the simplest possible statement of the solutions of problems which have confronted motion picture photographers and producers from the first, and you will understand that amateur technique, founded upon professional technique, but greatly simplified, is the most valuable aid you could find. Technique, under its familiar name "How-to-do-it," is a friend, not an enemy.

Amateur technique must be more flexible than that of the professional. It must meet a wider variety of demands. Many amateurs will make only pure record films. In this work the principal problem is that of the elimination of all non-essential detail, in case dramatization is purely selective. Starting at this point we find that we have a gradually changing field, the creative work creeping in little by little through the addition of details for better effect. We find this creative work increasing until finally we have a group of amateurs whose work is almost purely creative, who are following in motion pictures the path hewn by the Little Theatre Movement. This last group will very probably lead the professional to new artistic triumphs. However, realizing that the amateur field contains two diametrically opposed groups, and every conceivable combination of those groups, we must each of us make allowance for the prejudices of others who are not in our own group, and it is to be hoped that you will also make allowances for the writer who is trying to give

in a volume of such small size, an outline of amateur technique which may be of greater or less value to you all.

The first meeting of the club should be given over to a discussion of the work, of the production responsibilities each member can assume, such as properties, set dressing, make-up, costumes, and so forth. The general type of scenarios to be produced can also be discussed at this meeting and all preliminary work settled so that at the second meeting, the actual work of production may be started. As the start of any motion picture production is the scenario, this should be the subject of the second meeting of the club. And do not forget that whether your "Club" consists only of your own family or of twenty or more people, these facts are of equal importance.

CHAPTER EIGHTEEN

THE SCENARIO

The first step in the making of any motion picture is a visualization of the principal action of that picture. The scenario is the record of that visualization.

A scenario is a literary form distinct from all others. It is a story of action only. In it the abstract is kept to a minimum and when it appears at all is capable of being clearly interpreted by facial expression, gesture or other action. Action does not necessarily mean extensive action. A twitch of a facial muscle which gives definite expression to the face is truly "action." Therefore we have in the scenario a story which can be faithfully interpreted by the actors through the medium of the physical body.

The true scenario need not be used by the amateur as he can skip this step and go directly into the "Continuity" or "Script." This is the chassis of the scenario, a mere relation, scene by scene of the action required, and it is decidedly not a literary form. Many of the scenarios presented to amateurs have been in the form of a combination scenario-continuity. The continuity itself contains a wealth of information in a very brief space.

THE CONTINUITY.—In the case of the ordinary scene, the continuity indicates the scene number, interior or exterior, type of shot, locale, action and footage. Titles are indicated as captions or spoken titles, numbered, the wording given and footage. Inserts are given a scene number, a description of the subjects and the footage. Cut-backs are handled as regular scenes. It will be noticed that the scenario itself is not divided into scenes, it does not indicate footage, detailed business is not introduced and spoken titles are introduced in the usual manner by use

of quotes. In short the scenario is a readable *story,* while the continuity is little more than a "blue-print" for the Director's guidance. In case the action is more complex than usual, it might be well to write the scenario. This gives continuity of thought and action, and from this prepare the continuity or "Script." Some directors have each scene, title etc., written on a single sheet of paper, and in this form these sheets are usually called the "Slats." This makes the continuity bulky and has no real convenience, over the more usual form.

The home movie has come to stay. There will probably never be a pastime, a sport or a hobby which will attain the popularity which the movies have gained recently. There is a very sound reason for this. The movies provide the opportunity for the creative instinct, they are independent of external circumstances, they are personal in character and have a permanent, ever increasing value. Let us compare the movies with radio, which ranks next to them in popularity. The radio only transmits to us the creations of others, our part in radio is passive. The radio is impersonal, it appeals to us through our sense of hearing, and it has only a passing interest. A composition is played, we hear it and it is gone! With the movies our part is active, we create the film according to our own ideas and ability. The films which we produce are personal, they appeal to us through the medium of our principal sense, sight, and they are permanent, being a record of passing action which is captured, recorded and made available for reproduction at any future time. In fact, with the passage of time, the value of our films grows in geometric proportion. We have not yet had the possibility before us for a sufficient length of time to appreciate this last point, but imagine how you would value a movie of your parent's wedding, of your mother's childhood, or of father's school days. There is then a value in the amateur movie which far outweighs its value as a pastime. In fact, so tremendous is this value that as a nation we are coming to realize that no family can afford to be without a good motion picture camera, especially now that the 16 millimeter equipment has been so per-

fected and so simplified that it may be operated by anyone with entire success.

Success in amateur movie work is not solely a matter of securing films which are good from a photographic standpoint. If that were the case there would be but little reason for writing this book. The manufacturers have gone to great pains to prepare books of instructions for their cameras which make the actual operation very easily understood, and very often indeed the beginner secures a photographically good film at his first attempt.

There are certain aesthetic considerations which enter into the problems of film production, whether amateur or professional. These considerations make the difference between the uninteresting film and the interesting one. The problem involved with each one has been individually studied by the professional producers and we have their solutions ready at hand to be used for the betterment of our own personal movies. But before we can make the best use of the experience of the professionals, we must adapt their solutions of these problems to our own variations of such problems, which usually necessitates a change, not in the basic practice, but in the application of the general principle involved. For example, the professional director might plan on using twenty broadsides, a half dozen sun arcs, twenty Cooper-Hewitt banks and a few scattered 150 amp spots. The amateur, on the other hand is usually limited to two or three amateur twin-arcs or Cameralites with a small spot if he is lucky. It is obvious that the amateur must cut down his cast, his stage area and his action to conform to the covering power of his lighting equipment, yet both directors may interpret the same emotion upon the screen. The professional director knows that to please the public at large he must use space, people and props. He must spend money and let the audience know that he is doing so, while the amateur at his best, attempts only one thing, to achieve his desired dramatic effect.

The amateur movie maker is not a member of a uniform class. Some amateurs only want to make living records of some portions of their lives, but they want these records

to be truthful; others want to make for their own satisfaction motion picture dramas untrammelled by the conventions and restrictions which keep the theatrical motion picture in its present level; and between these two a vast throng who occupy every conceivable step in the intermediate space. Yet we cannot say that any one division is right and all the others are wrong. The movies give us a deep and permanent pleasure, they are a vital power in our lives, and in making life better, more enjoyable, they fulfil their destiny.

It is not the purpose of this book to try to win any amateur from his present aims and methods, but only to enable him to more quickly and more perfectly attain the goal which he has already set himself. If it enables the family historian to make better record films, or if it helps the cinema dramatist to make more artistic films, it shall have served its purpose. For this reason, it is necessary to say that there are many things mentioned which the beginner can for the present ignore, but which become vital as more ambitious work is attempted. Usually, this fact is mentioned in the text, but a little judicious thought will serve to indicate whether any given procedure is necessary in filming the baby in the backyard, or whether it is meant only for the use of the Little Cinema Club in their apartment-studio.

Development of the Scenario.—But, to return to the scenario. In writing this scenario or continuity, the first step is to write the entire story in a paragraph Let us consider "When Billy Started to School."

Billy, the baby of the family has reached the age when it is necessary for him to start to school. In preparing for this momentous event he has many surprising and amusing adventures.

This gives us a basis, a mass of color without detail. The second step is to break this paragraph into component bits, giving an idea of the action.

Billy tells Daddy of the coming event. He has to hurry to get ready. The other children quietly get ready for school. Billy is late. He is called and comes out with an armful of story books, and surrenders them to mother

only after considerable resistance. Billy and his brother Rob start hurrying down the sidewalk to school, while mother turns and re-enters the house.

Here we have a photo-play reduced to almost its simplest elements, yet it is one which can be easily adapted to any home in which there are children almost ready for their first day in school. With an idea of the component parts, our next step is to prepare the continuity in detail as has been presented to us in Miss Standing's delightful little family scenario, "When Billy Started to School." In order to present a concrete example of the amateur scenario at its best, we take pleasure in including in this chapter two complete amateur scenarios prepared through the courtesy of Miss Vera Standing, the well known writer of amateur scenarios.

THE DARK MAN IN HER LIFE

By Vera Standing

Scene 1—EXTERIOR. COUNTRY ROAD. FAIRLY LONG SHOT.

A few gypsies are hanging around a tent or two set up on the edge of a field, with woods in the background. A bunch of young people in camping clothes are in front of one tent.

Scene 2—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

Some of the boys and girls, all of high school age, are trying to push Betty toward the door of the tent. One girl says,

SPOKEN TITLE 1—*Go on, Betty, we've all been in, it's your turn now.*

She laughs and struggles, but finally goes in the tent.

Scene 3—INTERIOR. GYPSY TENT. SEMI-CLOSEUP.

Betty peeps into the tent, around a curtain hanging inside the door itself.

Scene 4—INTERIOR. GYPSY TENT. MEDIUM SHOT.

A gypsy woman, seated on a pile of rugs, motions to Betty to come forward. Betty crouches down in front of her and holds out her hand.

Scene 5—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

Rufe, aged about fourteen, one of the bunch, comes running around to the back of the tent and throws himself on the ground as close to the lower edge of the tent as possible, to hear what is said inside. He tries to lift the cloth a bit with his hand.

Scene 6—INTERIOR. GYPSY TENT. SEMI-CLOSEUP.

The gypsy studies Betty's palm carefully from all angles, talking rapidly at the same time. Betty leans eagerly forward.

Scene 7—EXTERIOR. COUNTRY ROAD. FAIRLY LONG SHOT.

A young man comes along, driving a very shabby flivver. The bunch see him and rush forward. He stops the car.

Scene 8—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

Everybody crowds around to say hello to the newcomer, who has very dark hair. One boy asks,

SPOKEN TITLE 2—*Hey, Don, when did you get here?*

Don begins to explain.

Scene 9—EXTERIOR. COUNTRY ROAD. SEMI-CLOSEUP.

Rufe is listening behind the tent, and giggling to himself.

Scene 10—INTERIOR. GYPSY TENT. SEMI-CLOSEUP.

The gypsy is saying to Betty,

SPOKEN TITLE 3—*The next dark man you meet will be very important in your life.*

Betty laughs and asks some more questions.

Scene 11—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

Rufe runs to the others, who are still around the flivver, and tells them what the gypsy is telling Betty. Don asks,

SPOKEN TITLE 4—*Who is Betty? I don't know her.*

One of the girls starts telling him who Betty is. Then a boy grabs Don by the arm and exclaims,

SPOKEN TITLE 5—*Oh, boy, you're it!*

Don wants to know what kind of an "it" he is, and the boy slaps him on the back and cries out,

SPOKEN TITLE 6—*Why, the next dark man in her life!*

All the rest go into a fit of laughing, and beg Don to play up to Betty. The boy who had the big idea shows Don just how to express a sudden mad crush for Betty. Don thinks it will be a scream and agrees. He gets out of the car.

Scene 12—INTERIOR. GYPSY TENT. MEDIUM SHOT.

The gypsy finishes her fortune telling. Betty rises, puts a coin in the gypsy's hand, and goes to the door.

Scene 13—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

One girl turns and exclaims that there is Betty now. They all go out of the scene in her direction.

Scene 14—EXTERIOR. COUNTRY ROAD. FAIRLY LONG SHOT.

The bunch run to Betty, who is just outside the tent, and hustle her toward Don, who is approaching slowly.

Scene 15—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.

Don is introduced to Betty, who greets him cordially, but is mystified by the giggling and nudging around her.

Scene 16—EXTERIOR. COUNTRY ROAD. SEMI-CLOSEUP.
Don and Betty smile at each other, with the others crowding around.

Scene 17—EXTERIOR. COUNTRY ROAD. CLOSEUP.
Don and Betty only, smiling at each other.

Scene 18—EXTERIOR. COUNTRY ROAD. SEMI-CLOSEUP.
One of the fellows, getting impatient, pokes Don in the ribs, and is astonished when Don snaps at him to cut it out. The boy raises his eyebrows and whispers to his neighbor, who laughs.

Scene 19.—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.
Betty asks the rest if it isn't time to go on. They all feel rather let down, and whisper a bit together, then start down the road by twos and threes, Betty among them.

Scene 20—EXTERIOR. COUNTRY ROAD. LONG SHOT.
The bunch are straggling along the road, and Don gets into his car and drives after them. He invites Betty into the car, and she accepts.

Scene 21—EXTERIOR. COUNTRY ROAD. MEDIUM SHOT.
Don and Betty pass a group on foot. The walkers look at each other and laugh.

Scene 22—EXTERIOR. COUNTRY ROAD. CAMERA RUNNING ALONG WITH AND A LITTLE AHEAD OF THE CAR. MEDIUM SHOT.
Betty keeps her eyes straight ahead, and does not say a word. Don looks at her, looks ahead, looks at her again. Finally Betty says,

SPOKEN TITLE 7—*Will you do me a great favor?*

Don exclaims eagerly that he certainly will, and she continues,

SPOKEN TITLE 8—*Will you please bleach your hair,*

Don looks stunned, then the point dawns on him, and they both laugh uproariously. Don asks,

SPOKEN TITLE 9—*Is that all you have against me?*

Betty nods, giggles, and sits a bit closer to him.

Scene 23—EXTERIOR. COUNTRY ROAD. CAMERA ON BACK OF CAR. SEMI-CLOSEUP.
The back of Don's and Betty's heads, quite close together, as they drive along.

WHEN BILLY STARTED SCHOOL

By Vera Standing

Scene 1—INTERIOR. DINING ROOM. TABLE IN THE FOREGROUND AND DOOR TO ONE SIDE OF THE ROOM. MEDIUM SHOT.

Daddy and Beth and Rob are already at breakfast. Daddy is reading the paper while he eats. Billy, aged six, comes running in and stops beside Daddy, while Mother follows after and sits down at her place. Daddy drops his paper as Billy reaches up to him. (3-1/3 ft.-8 ft.)

Scene 2—INTERIOR. DINING ROOM. CAMERA ON SAME SIDE OF TABLE AS CHARACTERS. SEMI-CLOSEUP.

Daddy bends toward Billy as the latter says excitedly,

SPOKEN TITLE 1—*Daddy, I'm going to start school to-day.* (2-5)

Daddy pretends to be immensely surprised, and carefully measures Billy to see if he is big enough. Then he gives Billy a big hug. Mother comes partly into the scene and draws Billy gently toward his chair, between his parents. (5-12)

Scene 3—INTERIOR. DINING ROOM. CAMERA BEHIND AND A LITTLE TO ONE SIDE OF CHARACTERS. MEDIUM SHOT.

Mother ties on Billy's napkin and points to the clock on the opposite wall. (2-5)

Scene 4—INTERIOR. DINING ROOM. CLOCK. CLOSEUP.

The hands of the clock point to eighty-thirty. (2-5)

Scene 5—INTERIOR. DINING ROOM. TABLE IN THE FOREGROUND. MEDIUM SHOT.

Beth and Rob are arguing amiably and eating. Billy stops in the middle of a mouthful of cereal to ask a question, but Mother keeps him at his meal. Daddy gets up from the table and kisses Beth and Rob good-by. As he turns to Billy, the latter climbs up on his chair. Daddy puts his arms around him and says,

SPOKEN TITLE 2—*Be sure to tell me what you did in school, when I get home to-night!* (5-12½)

Billy says, oh, yes, he surely will, and Daddy smiles at Mother over Billy's shoulder. Then he and Billy hug each other hard, and Daddy goes out, while Billy climbs down again. Mother tells the three children to go and get ready, and they all leave the room. (10-25)

Scene 6—EXTERIOR. FRONT YARD. FRONT PORCH IN THE REAR. LONG SHOT.

Mrs. White and her little girl Julie walk up the path into the scene. Mother comes out to greet them. (3½-8)

Scene 7—EXTERIOR. FRONT PORCH. HOUSE DOOR IN THE SCENE. MEDIUM SHOT.

Mother is talking to Mrs. White. Beth and Rob come out, ready for school. Beth and Julie compare pencil boxes, and Rob tells Mother that Billy isn't ready. Mother calls through the screen door to Billy, who comes out a moment later, with his cap on, and with his arms so full of books he can hardly hold them. (5-12)

Scene 8—EXTERIOR. FRONT PORCH. DIFFERENT ANGLE. SEMI-CLOSEUP.

Mother is bending over, full of laughter, as Billy hangs on to this bunch of his story books and says,

SPOKEN TITLE 3—*I guess these will have to do me for to-day.* (4-6)

Mother is simply convulsed as she takes two books from Billy and looks at them. (2½-6)

Scene 9—EXTERIOR. FRONT PORCH. CLOSEUP.

Mother's hands hold two books with their titles plainly visible. ("Peter Rabbit" or other stories usually read to little boys.) (2-5)

Scene 10—EXTERIOR. FRONT PORCH. STEPS AND PART OF PATH IN SCENE. MEDIUM SHOT.

Mother induces Billy to give her all the books. Mrs. White looks at her wrist watch and says the children must hurry. Beth and Julie run down the steps and out of the scene. Mother kisses Billy and tells him to take Rob's hand. Billy hangs back, but Rob says, "Aw, come on, kid," so they go down the steps hand in hand, with Mother and Mrs. White behind them. (6-15)

Scene 11—EXTERIOR. STREET. FRONT OF HOUSE AND SIDEWALK LEADING OUT OF THE SCENE INTO THE DISTANCE. LONG SHOT.

Beth and Julie are half-way down the block. Other children come out of a house and join them. Rob and Billy are coming at the same time down the path from the house, while Mother and Mrs. White stop a little below the front steps. Billy turns as he reaches the sidewalk, and darts back to Mother. (3½-8)

Scene 12—EXTERIOR. FRONT YARD. MEDIUM SHOT.

Mother holds out her arms as Billy runs into them and throws his arms around her neck. He looks back at Rob and shakes his head, but Mother pushes him from her and reassures him. Then she takes him by the hand and leads him to Rob. (5-12)

Scene 13—EXTERIOR. STREET. SIDEWALK RECEDING AT AN ANGLE. SEMI-CLOSEUP.

Mother closes Rob's hand tightly over Billy's, and gives them both a push, telling them to hurry up, or they'll be late. (3½-8)

Scene 14—EXTERIOR. STREET, A LITTLE FARTHER UP. MEDIUM SHOT.

Billy and Rob come along the sidewalk toward the camera. Billy is trotting to keep up with Rob. He has lost all his fear, and is talking excitedly, while Rob nods and grins. (4-10)

Scene 15—EXTERIOR. STREET. LONG SHOT.

Mother and Mrs. White are standing on the sidewalk watching the children. As the two boys reach the corner, in the distance, Billy turns and waves his hand. Mother waves frantically back. (2½-6)

Scene 16—EXTERIOR. STREET. MEDIUM SHOT.

Mother is waving to Billy, who is not in the scene. (2-5)

Scene 17—EXTERIOR. STREET. THE CHILDREN AS MOTHER SEES THEM. LONG SHOT.

Billy stops waving as Rob hurries him around the corner and out of sight. (2-5)

Scene 18—EXTERIOR. STREET. MEDIUM SHOT.

Mother winks a tear out of her eye and smiles at Mrs. White. She smiles back and links her arm into Mother's. They turn and walk up the path toward the house. (4-10)

Scene 19—EXTERIOR. ANOTHER STREET. SCHOOL HOUSE IN THE DISTANCE. LONG SHOT.

Billy and Rob walk into the scene and hurry toward the school. Other children are running into the building. Rob points out the school house to Billy and they both begin to run. They finally reach the building when all the other children have disappeared, and they go in too. (8-20)

NOTE—The first of the two figures in parentheses are estimated footage for 16 mm. film, the second, for 35 mm. film. The total footage for 16 mm. film is 76 feet of scenes and 11 feet of titles, or 87 feet in all. For 35 mm., standard, film, it is 185 feet for scenes and 21 for titles, or 206 in all. Either film will run about three and one-half minutes on the screen.

A little study of these two excellent examples of the scenario as adapted to home production will show that their construction is not difficult. It is true that there is not much of melodramatic character in these two examples, but melodrama is a thing apart, and not one which is to be recommended. Advanced drama is quite admirable, and a goal toward which to strive. To that end, scenarios similar to those just given will be prepared, but more elaborate.

The scenario presents in clear, concise form a sequence of related scenes which serve to carry forward a theme to its culmination. Just what does that mean? "Clear and concise form." The ideas presented must be capable of being interpreted by physical means which can be recorded by the camera. The intent of the action must be unmistakable. All superfluous details must be suppressed or removed. "A sequence of related action." Each scene must have some essential bearing upon the development of the theme or story, and such scenes are presented in such order that the action of one scene logically succeeds the action of the preceding scene. There is an exception to this when in a change of sequence, the sequence logically succeeds some preceding sequence. "Which serve to carry * * * to its culmination." The action is introduced at some predetermined point. From that point the in-

terest must increase until we arrive at the crisis or the dramatic denouement toward which all of the action has led us.

THE SEQUENCE.—We often have to carry forward two separate and distinct groups of action. In this case that group of scenes which depicts the uninterrupted action of a single group is termed a sequence. Thus we show a sequence dealing with group one, then a second sequence, whose time of occurrence may have been coincident with that of the first sequence, but which shows us group two. As a sequence may contain any number of scenes from one upward, it is evident that we should have some indication of sequence change. This is provided by the fade or the iris. We iris in on a sequence and iris out at the close of that sequence. It is immutable law that a fade out or iris out *must* be followed by the fade in or iris in. If a title is inserted between sequences this still holds true, the title is circled in and out and the following first scene of a sequence is opened by the iris in. Such fades and irises must be indicated in the scenario.

PLOT DEVELOPMENT.—There are certain conventions which, while not inflexible, have proven to be very efficacious in producing the desired effect.

The first two or three scenes should introduce one or more principal characters, and with the introductory title inform the audience what the story is about. This is one of the more difficult if not the most difficult part of scenario preparation. We have a whirr, a flash, and a story starts upon the screen. The spectators are not aware of the subject, yet they must be made to feel perfectly familiar with the story from the first sequence. The introductory title should not be lengthy and tiresome, but should tell volumes in a few words. The better class of professional feature pictures offers excellent examples of this. Often the first two or three or even more scenes have no direct connection with the story. They could be omitted without detriment to the development of the plot, but they serve to introduce the characters and the theme.

One valuable artifice is suspense. For some reason it is apparently the goal of the amateur scenarist to tell the

whole story in the first sequence and to then return and go into detail. This is to be avoided. Such practice may be very well in newspaper work where the whole story is told in the first paragraph and later elaborated, but in motion picture production such a course is ruinous.

Keep to the gradual development of the story. If you find that the denouement is going to be disclosed before the proper time, cut the sequence, leave the audience hanging in mid-air, so to speak, and cut to another sequence. Suppress the critical denouement until the time arrives for the logical inclusion of the crisis.

Do not waste film on trivial detail. Make each scene mean something! If a scene can be eliminated without injuring the story—eliminate it! Its presence is worse than its absence. However, do not mistake the value of the introduction of slight but significant details which take place coincidently with a major scene. The modern director makes use of this trick in introducing a dog which runs to meet its master returning after a long absence, and similar "human interest" details which are common in modern feature pictures.

Following the crisis we have the "Finale." This has no true place in the development of the plot. This development reaches its culmination in the crisis, but by the time the crisis has been reached in a good photo-play the spectators are in a condition of extreme mental tension, which is only partially relieved by the critical point of the development of the plot. It is advisable to present a scene, or sequence following the crisis which presents in a generalized way the thought embodied in the concluding sentence of so many of our childhood fairy tales, "And so they were married and lived happily ever after."

This finale serves to relieve the tension induced by the dramatic events of the photo-play. Remember that in this photo-drama we have presented in ten minutes or so the dramatic elements which ordinarily are experienced in real life only in a much longer period. We have selected the highlights of a life story and have strung them upon a thread of continuity like a string of brilliants. They present drama in highly condensed form. Therefore the

reaction of the individual, although he is only a spectator, is quite often as acute as though he were an actor in a similar drama in real life. Do not neglect, then, the very necessary finale.

There you have in a half dozen paragraphs the science of scenario building, just as taught in extended courses of instruction. Naturally we do not state that the reading of these paragraphs will give you the same grasp of the subject as would such a course, nor may you expect this information to enable you to sell hundred-thousand dollar scenarios to the big producers—but seriously these points are the highlights of the subject which, it is hoped, will enable you to prepare simple home continuities.

Scenario Construction.—As to the actual construction, we find that the scenario, the working scenario or continuity, is composed of a series of paragraphs, each of which presents one scene in full. In some scenes we find titles, flash-backs and inserts included but broadly speaking there is one paragraph to each scene. This paragraph is built in a specific manner, each writer having his own style, but adhering strictly to that style, so that in production the information will be given in a standardized sequence, which will do much to avoid confusion in production.

Thus in the scenarios presented in this chapter we find these items of information given in order:

1. Scene number
2. Interior or exterior
3. Locale
4. Subject
5. Camera angle
6. Detailed description of the "business" of the scene
7. Inserts, titles or other similar cut-in when necessary
8. Continuation of 6
9. Footage as determined for 35 or 16 millimeter film, either or both being given

It will be seen that in condensed form, a considerable amount of information is given the director. The last point (9) is not unalterable. It is given as an approximate guide for the director in order that he may conclude

the entire action in the footage allowed. In most cases the home drama will be limited to the usual 100 foot spool. Thus in "When Billy Started to School" we have 87 feet of film called for. This leaves 13 feet from the 100 foot spool. This 13 feet will just about take care of fractional minute over-runs, fogged frames and other waste eliminated in edition. When completed we find that this film contains from 80 to 90 feet of film if the scenario has been followed as closely as possible.

Scenario writing is an art in itself. Few indeed are the truly great scenarists, for the work demands many mental qualities not often associated, but there is no reason why every camera owner should not prepare his home scenarios for the betterment of his films. No matter how crude the attempt the film will be better than it would have been without it.

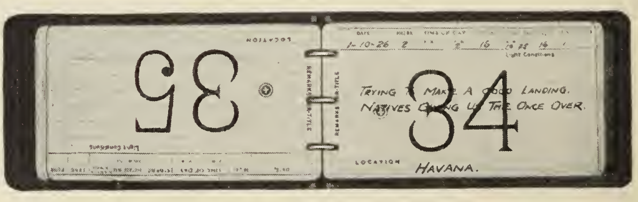
So, do not hesitate to essay your first scenario. Who knows but what you may be one of the as yet undiscovered scenarists for whom the motion picture world has been waiting? But even if you are not, you will derive an infinite amount of pleasure from this work.

CHAPTER NINETEEN

PREPARING TO SHOOT THE AMATEUR FILM

When the company has been organized, and a suitable scenario has been prepared, the time has come for the actual preparation of the scene of action. This is a time which has, no doubt been looked forward to by almost every individual in the cast. But before the actual rehearsal can be started, it is necessary to arrange the place in which the action is to take place and to prepare certain accessories which will be used in the action. As generalities convey little information, and as there is not room here to consider even the leading types of scenarios, let us take one type of scenario as an example. The procedure followed will indicate the procedure which will prove most successful for other types of production.

Let us consider a full reel production. This contains 400 feet of film and requires approximately sixteen minutes for projection.



(Courtesy Bell & Howell)

When a scene is filmed it is always good practice to make a permanent record of the data right upon the film. For this purpose a scene record booklet such as the one shown here, contains the blank cards ready to be filled out and photographed directly upon the film.

VACATION FILMS.—We have a "vacation" type of film. In this the "hero" is a fisherman. He and his wife go to a fishing camp (camp shot). He starts out early in the morning (sunrise shot, long shadows, water and trees).

After fishing for some time he secures a sufficient number of fish for breakfast (sporting shot). He returns to camp with his fish, where he proceeds to prepare them for cooking (comedy shot). Then his wife cooks them in a frying pan over the open fire (camp shot). This is a type of film which appeals to almost every one, both those who fish and those who only wish they could.

Naturally this is a more or less record type of film, but even so, the usual preparations will add greatly to its interest. The first step is the determination of the locations. In each case these must be selected with view, not only to inherent beauty and pictorial composition, but also regarding the motion which will take place within the frame area. The composition should be such that the eye is drawn from any point of the boundary toward a point in the middle foreground. At this point the campfire is built. Do not arrange the composition so as to throw this fire in the exact center of the frame, have it fall at one side or another. With the fire located in the natural focus of interest, the other details such as the tent and other parts of the set are arranged in proper relation to this central point of interest.

This is the principal locale. The second in point of interest is the one in which the actual fishing takes place. In this location attention should be given primarily to the pictorial setting. If the arrangement is carefully watched, the conventional angular stream may be allowed to wind across the picture area while the fisherman is kept in the middle distance and at one side of the frame, casting upstream and across the frame. This will enable the pictorial composition to be kept unmarred while the action proceeds without interference.

The other locations for this scenario are incidental and may be selected as the need arises. Two or three angles should be selected from which the first set may be shot with equal effectiveness.

When the locations have been determined upon the next step is to dress the set. A fire is laid and started. It is evident that with only 100 feet of film at our disposal we cannot show the actual camp-making. For this reason

we will break into the story with a first shot showing our fisherman picking up his rod and creel and starting out, the preliminary facts having been told in the title. We set up the tent and with branches we arrange a rustic washstand and towel rack with a mirror swung from the bole of a living tree. In the ashes near the fire we set a coffee pot and hanging on a trimmed bush nearby the frying pan and other cooking utensils common in camp life. *Do not* insert a lot of kitchen furnishings such as double boilers, cake turners, baking pans, and so forth. The coffee pot is not a percolator, but a common, garden variety of tin coffee pot beloved of campers, the frying pan is of light pressed steel, and if the cook cannot "flap" a flap-jack the hungry fisherman will go hungrier for cake-turners are taboo in camp life! In other words do not make your film absurd by the use of properties which would not be found in the same location in real life.

This completes the preliminary work, and you are now ready for action as soon as you have suitable light. It is better to shoot the fishing scene first as here you have the open sky above the water and the reflection from the water itself to help you in the early morning light—a light which cannot be successfully faked. Upon returning to the camp you will then, no doubt, have plenty of light to make both the first and last sequence of this simple three sequence playlet. Do not forget that reflectors are almost as important outdoors as the arcs are indoors.

So much for the naturalistic photo-play. The more conventional drama is somewhat more difficult to prepare. In many cases interior shots will be called for. In the old days and even in days not long past in amateur cinematography odd angles on the outside of buildings were used for "faking" interior shots, but in the case of the usual amateur such scenes might as well have been labelled "This scene is faked." There is but one place in which to make an interior shot and this is inside some building.

The Attic Studio.—An attic makes a wonderful stage, as it usually has many nooks and corners which are easily converted into anything from the dungeons to the parapet of a castle. The attic may be lined with light wallboard

and this in turn painted with kalsomines over and over again, enabling your scenic artist to paint a fresh set for each new play attempted. Finally, the interior shots, illuminated by the type of arc made for amateur use have a character which very closely imitates professional quality.

A supply of black, white, brown and blue kalsomine (water mixed) paints will suffice for almost any scenic work needed. Blue, used alone will photograph very lightly, black and white are used in mixtures to secure the photo-grays and the brown added to give a warm tone, killing the blue-black tone of the darker black-white mixtures.

In dressing the set the amateur craftsman will be in his glory. A full supply of thin tin plate, tinfoil, burlap, wire screen cloth, plaster of paris and paint will set him up as "Props." With such a supply of material he will be able to deliver practically any prop you may demand from an Egyptian sistrum to mediaeval bill-hook or modern cigarette box. Armor is made of tin plate and tinfoil glued to more tractable material. Boulders are made of screen wire irregularly stretched over wooden supports. This is in turn covered with plaster and painted. Stumps and logs are made in the same way, jewelry is made from tin-plate or purchased at a ten cent store.

In fact, a little ingenuity, the materials mentioned above and the tremendous array of miscellaneous articles found in the usual home will solve the question of properties. In case you are working with "period" or "costume" plays, it is always a very good idea to go to the public library and there look up the various articles as well as the costumes proper for the period and class represented.

In practically every club there will be one or two members who are willing to take over the supervision of properties and costumes.

Costume.—Of course in modern plays the question of costume is quite simple, but in plays of other days it is necessary that costumes be made for the occasion. In this work it is well to note that there are many cotton weaves which in every way simulate the most expensive silks and

satins upon the screen. A piece of new, cheap velveteen will photograph to better advantage than a slightly worn piece of the finest velvet ever loomed. In every public library there are books which give full detail regarding costume, jewelry, arms, furnishings and so forth. The wardrobe mistress of your club should have no difficulty in making costumes from inexpensive materials which will closely simulate these originals.

There is another side to the question of costume which affects modern as well as period costumes. This is the question of color. There is much which might be said in this connection, but as has been explained in another part of this book, our colors affect the film in direct relation to their position in the spectrum. Thus red, having practically no action whatever is photographed as black and blue, the most active of all colors, photographically, is photographed as white. With these facts as a guide it is possible to estimate the photographic tone which will be given by practically any pure color, but when mixtures are involved, or various shades, tints and other color variations the poor amateur may be excused for losing his ability to even recognize the visual color of his subject, but the final test is the monotone filter, which has been mentioned before. This filter may be carried and used to test the photographic color of cloth and other materials to be used in this work.

Make-Up.—A consideration of costume brings us naturally to a consideration of make-up as the two for some unfathomable reason seem to be inseparable. In professional work make-up is divided into two classes, straight and character. Straight make-up is used, strangely enough, to give the actor a natural appearance upon the screen. We have found that the photographic emulsion plays strange pranks with color. This is even more pronounced in portraiture. Here we see spots, and patches appearing in what appears to be in real life, a flawless complexion. This is a familiar phenomenon in portraiture and the true reason for retouching without which a professional portrait is never delivered.

As it is evidently impossible to retouch each of the

tiny individual pictures which go to make up the motion picture, we must "retouch" our actors and more particularly our actresses before the camera is brought into action.

This straight make-up is accomplished in this manner, although each individual actor has his own variations of this standardized process:

The face is thoroughly cleansed and given a heavy coating of cold cream. This is rubbed in with a circular massaging motion. After the skin has absorbed all the cream it can, the surplus is wiped off. Then the yellow grease paint known as "Motion Picture Yellow" is applied in broad streaks and rubbed in just as was the cold cream. This is continued until all exposed skin of the head, face, neck, ears, back and breast is covered with a uniform yellow tint. The brows are wiped as free of grease and cream as is possible. The lips are given a touch of rouge lighter than the natural color, the expression lines are drawn about the eyes, the eyes shaded. Then a liberal, a very liberal coating of motion picture powder is applied and finally the brows and lashes given their coloring of mascaro.

This constitutes the usual motion picture make-up. It is a tedious and difficult process at best. When completed it is so delicate that a scratch, a rub with a handkerchief, a careless touch in fact will mar it. This make-up is neither necessary nor desirable in amateur cinematography. The public has come to expect and so demands unnatural perfection in the complexions of the stars, but your own friends would be almost unrecognizable in full professional make-up.

A light application of cold cream may be used as a powder foundation. Only enough cream should be used to leave the face soft and slightly greasy to the touch. No visible cream should be allowed to remain. Over this is dusted the motion picture yellow face powder until it appears dry and soft. A touch of mascaro upon brows and lashes completes the amateur make-up. The eyes may be lined if preferred, and a slight shadow may be worked in upon the upper lid but these touches are not really necessary. Remember, the lighter the make-up the better

the amateur film will be. In many cases, all that will be necessary will be a mere touch of powder to prevent any shining noses.

Remember that red photographs dark, so if you must use a lip stick get the lightest shade you can find, but do not, *ever,* rouge the cheeks. The writer recently saw a feature picture produced by one of the largest and best known producing companies, in which the star had rouged cheeks. It was very annoying, for one felt that she had inadverentently rubbed up against a coal scuttle!

Character Make-Up.—Character make-up is another question entirely. Here we have to make use of various artifices in order to present the actor in a role which is widely different from that which he plays in actual life. The finest character roles are a result of the actor's ability to merge his personality with that of the character rather than as a result of artistically applied wax and grease. The make-up accessories are simple. Crepe hair for beards, brows and so forth; nose putty for building bumps, large noses or other protuberances which are not natural to the actor; black wax to simulate lost teeth; enamel to cover a gold tooth which might go black (this is also used in straight make-up as gold teeth are most repulsive upon the screen) wigs, false whiskers, spirit gum and an assortment of grease paint. If you wish to make-up for a character part, secure a photograph of a type which you wish to represent and then line for line, feature for feature copy this face upon your own, using the putty to build up, dark paint to create hollows, and so forth. For repulsive roles artificial tusk-like teeth, "blind" eyes and similar devices may be secured from costumers and novelty shops.

Lighting the Set.—With the set built, props in place, the cast costumed and made up, you are ready for the actual rehearsal. If the shot is exterior you now place the reflectors and if interior, the arcs. In the chapters on lighting the proper setting for illumination has been discussed as well as certain other phases of lighting. Remember that the light serves (a) to give the necessary illumination to make photography possible (b) to give depth

to the scene (c) to add to the psychological spirit of the production. The first consideration has been fully discussed.

In photography we are dealing with a four dimensional reproduction. We have the geometrical dimensions of length and breadth, as well as the less tangible dimension of time, but depth may be represented only by illusion. As this is quite necessary, we should clearly understand that there are four major ways of producing this illusion. First we have the linear perspective. Here we unconsciously estimate depth due to the progressively converging parallel lines, the usual perspective as taught in elementary drawing. Second we have the aerial or atmospheric perspective in which distance is simulated by a constantly decreasing contrast, which makes distant hills appear to be clothed in haze. The third effect is one of lighting, where properly placed lights give an appearance of roundness, and thus solidity to the object and the fourth is a trick of illumination, in which an object in the foreground is strongly lighted leaving the background comparatively weakly illuminated.

In professional productions, all of these effects are subject to manipulation, but the amateur is advised to take the first two as he finds them. They are useful only in exteriors or unusually large interiors, while the last two may be, should be used in every interior scene.

The third effect, that of securing roundness has been discussed in the chapter dealing with interior lighting. The fourth consists merely of giving the principal subject a different intensity of illumination from that given to the rest of the scene. The backlight is one of the most common examples of this device in which an intense light thrown upon the back of the actor renders unmistakable the distance existing between him and the background.

The next step is to study the set carefully to see if the style of lighting corresponds to the mood of the scene to be enacted. This has also been explained, and illustrations given. In this remember that if you can give the maximum illumination to the center of the set and allow all edges to fall away slightly in illumination you will

secure a soft edge effect not unlike that secured by the professional who makes use of chiffon edged four way mattes. This does not mean that a spot should be used to throw a circle of light into the set, although this device is often quite effective. If the lights are all set fairly close to the set and directly toward the center of the angle, this effect will usually be secured without further manipulation.

(*Courtesy Amateur Movie Makers*)
A typical amateur company on location.

Finally, do not try to use too much light. You will be surprised to learn what beautiful effects may be secured by giving the leading actor a full illumination and letting the rest of the scene go darker. This gives an effect which is entirely apart from the pseudo depth indicated, and has to do with the psychological effect produced by the scene. In real life we seldom have interior illumination of a glaring character. To-night, look about you, watch the members of your family as they move about the room. Notice how great is the difference in the amount of detail which you can see and that which is disclosed by daylight. It is a well known fact that there are hundreds, yes thousands of ladies in society who are ravishingly beautiful by artificial light, but who appear terribly haggard and worn

by the pitiless light of day. Artificial light is far less revealing than daylight, so do not try to secure the full, brilliant daylight effect in interiors.

Examine the set carefully, see that no extraneous articles are within range of the camera. If all is set and ready to shoot, call the actors to the set for the first rehearsal.

CHAPTER TWENTY

DIRECTING THE HOME FILM

With the actors upon the set you are ready for rehearsal and direction. You must learn to direct action at your ease, and with all confidence, for good direction is vital to the production of any film.

Every film which is worth the celluloid upon which it is printed, is the result of a definite amount of direction and rehearsal. There is little to be said of rehearsal which is not covered by the simple rules of direction, for the two processes are different phases of the same process. Direction is a mental process, the physical application of which is rehearsal. The cinematographer who is his own director, tells his actors what to do. This is direction. The actors follow these instructions, and this is rehearsal.

When working with adults it is well to go through the action a few times, actually operating the empty camera. This will accustom your actors to the novelty of their positions and remove a certain amount of self-conscious stiffness. However, beware of too much rehearsal, for it will result in the stiffness of routine work. Thus, it is evident that a happy medium must be found. When working with children about all that can be done is to get the child into the right mood and then crank when the opportunity offers. This procedure is familiar to those photographers who are accustomed to Graflex work with children. The cinematography of wild life is an art in itself, and "direction" consists simply in knowing the habits of the creatures being photographed, and utilizing this knowledge to obtain such action as may be desired.

Direction is both an art and a science within itself. A successful director, whether he directs a photo-drama, an orchestra or a stage production, must combine two char-

acteristics which are almost diametrically opposed. He must have the artistic sense developed to the utmost; and at the same time, he must ever keep cool and watch carefully the details of mechanics and technique. There are few rules which can be applied to direction, and these few are necessarily most elastic. It can be easily understood that direction by hard and fast rule would result in a photo-play of such mathematical inflexibility that it would serve only to produce the utmost boredom in the spectators.

You may well think that all of this has nothing to do with you and the production of a simple, domestic photodrama; but on the contrary, it has everything to do with you. The intimate little home "shots" you will make will be immeasurably better and far more interesting if a little thought is spent upon intelligent direction.

Before attempting direction, the art of camera manipulation must be mastered until all movements are made automatically and without conscious thought on your part, for all of your conscious energies will be necessary for direction. The position behind the camera, which you will occupy by virtue of being cinematographer as well as director, is the ideal position for direction for then you will see the same field of action which the camera sees. If you will observe all the photographs of great directors in action you will notice that they are usually near the camera, in fact, they will be found just beside it, or immediately in front of and just far enough below the lens to escape blocking the lens view. In the course of his professional experience, the writer has known directors who stated that they could direct from the sidelines or other remote positions; but such directors are found in small companies and in small companies they will stay, for the feat is beyond the powers of visualization possessed by any but a truly superman. Unquestionably the position of the cinematographer is the ideal directing position. This will be realized by amateurs who have experimented with various viewpoints when photographing some scene or individual. A very slight, indeed, an almost imperceptible, change in the position of the lens will often produce startling changes in the appearance of the finished print. If

you have not tried this, take a reflecting camera and look into the hood. *Swing* the camera from side to side. Objects in the immediate foreground will cross the screen in the same direction in which the lens is moving, objects in the middle distance will move absolutely in the same direction, but relatively in the opposite direction, and objects in the background will move positively with the foreground but at a much slower rate. Now set the camera on a tripod, place yourself some feet to one side and with a notebook, sketch the relative positions of various objects within range of the lens as you think they will be rendered. Now go and look at your camera screen. Compare your sketch with the actual view. You will be amazed at the result. So, when the camera is running while you direct, remember to stay near it. *Never* go into the field of action and maul your actors around with your hands as though they were puppets. You will only get an abominable and unnatural stiffness. Tell them what you want done and let them do it. The interpretation of the actor may not be your interpretation, but you must remember that it is this very individuality and consequent variety in interpretation of action which gives that elusive personal quality to a photodrama which makes for success. Direct action, suggest appropriate "business," but leave the details of interpretation to your actors. Remember that a super-abundance of individuality is the characteristic which has placed our great screen stars at the top of their profession.

However this should not be taken to mean that the cameraman-director should not also enter the scene as an actor. With the modern automatic camera it is quite easy for the cameraman-director to enter certain scenes where numbers are needed. He can direct rehearsal from the camera position, then start the camera, enter the scene and leave it only when necessary to stop the camera.

Laws of Direction.—As for the rules of direction, "They are few in number." The mathematician has set rules. To the best of my knowledge, two and two have made four ever since creation, but that is science. The rules of art are constantly transgressed to the infinite betterment of art; and directing is an art. I cannot too strongly im-

press upon you that each of the following rules should carry the prefatory phrase, "When the action does not demand otherwise—" These rules are not arbitrary, but are the result of long experience of a generation of directors who have produced our professional photo-dramas. As they are primarily mechanical in origin, they are just as applicable to the home-playlet as to the most elaborate spectacle, in fact, more so, for the elaborate super-film may at times demand the transgression of every rule mentioned here, but the home-film will usually abide by them.

Do not let your actors carry their hands or other objects between their faces and the lens. In the photo-drama the face is the center of interest. The facial expression must bear the burden of telling the story, supported by such pantomime as may be used. Thus, the alternate hiding and disclosing of the face comes to the spectators like a periodic and annoying interruption while reading. However, in photographing a coquette flirting with her fan, it would be absurd to try to follow this rule. Also the grace of certain interpretative dances would be ruined by strict adherence to this rule. Neither should your actors impale their cigars upon pickle forks in order to smoke without breaking the rule. A little thought will immediately show any necessity for ignoring this rule.

Do not let one actor come between another actor and the lens any more than is vitally necessary. This requires a word of explanation. The supernumeraries, or the extras as they are more commonly called in motion picture work are not, strictly speaking, actors. Their true position is more exactly defined by the expression used by some directors to describe them collectively—"atmosphere." They fill out the scene just as do palm trees or steamer chairs. When the scene demands a crowd it would be absurd to film an empty set, but they are not actors and as such are to be absolutely disregarded in the above rule. The reason for the existence of this rule is aptly illustrated by the familiar story of the store-group photograph.

A large department store had a Circut photograph made of their employess. One diminutive cash girl carried her copy home and displayed it proudly to her mother. "See,

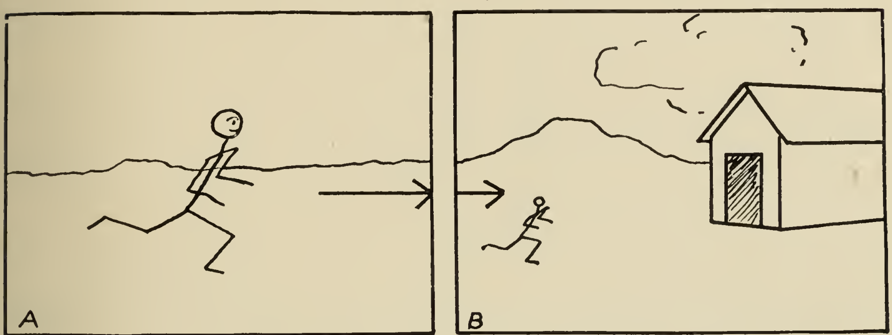
mom," she said, "right here at this end is Sadie Milligan; then, see them legs just behind her? Well, them legs is me!"

So, in your motion work. Do not let any of your principals be so hidden that they have to be identified by "Them legs" or by any other detached portion of their anatomy. It will be thought naturally, using a typical example, that in making a film of Baby that Mother is merely an accessory, atmosphere in fact; but to have her face alternately obscured and disclosed is even more nerve-racking than to see a snap-shot of a pretty girl from whose head a fully matured oak tree is growing. Keep your principals working in opposition and clear of each other—except where the action demands otherwise. (A love scene would decidedly lack punch if the principals kept clear of each other.) The writer does not wish to make a bore of himself by constantly repeating, "When the action does not demand otherwise," but it has been his experience that amateurs—beginners, rather—find a constant alibi in the expression, "The book says thus and so and I did thus and so." Remember, knowledge is the tool of the master. He knows the reason for the rule; and therefore, knows when it should be broken. The best advice for the amateur who would be successful is this: Master your art.

Entrances and Exits.—Another test of the finished director is his ability to keep entrances and exits disentangled. They will prove most troublesome, and their apparent insignificance will but add to the difficulty, for until one film with scrambled entrances and exits has been made, the beginner in cinematography will very probably disregard them. Many otherwise good directors have to figure entrances or exits on paper, or have an assistant do it for them.

Off Screen Action.—One would naturally think that an actor could leave the screen at any desirable point and re-enter it at that spot which was the least obstructed; but owing to a psychological twist of our minds, and one by-the-way which makes photo-drama possible, we are prone to follow the actor *while he is absent from the screen.* Should anything occur to disturb the direct continuity of

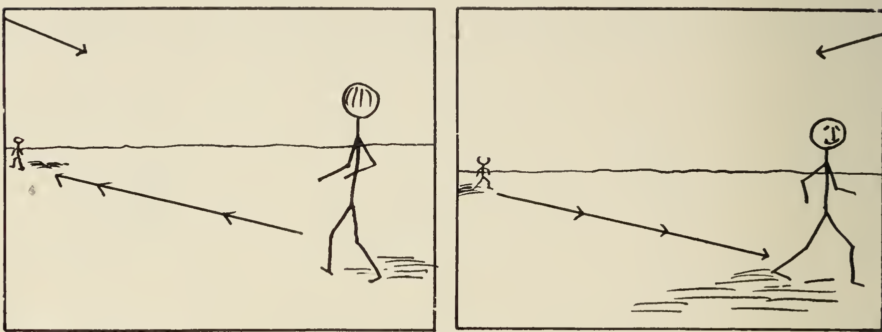
this off-screen action we are vaguely disturbed and the resultant confusion of mind prevents a full enjoyment of the drama we are watching. To those to whom this subject is new, this sounds like sheer nonsense, yet careful thought and study of successful screen plays will demonstrate that some of the most important action, action in



In the diagram "A" the actor is running across the screen and will exit at the right, his direction of movement being indicated by the arrow. In diagram "B" it will be noticed that the camera has been moved back and a much larger field included. This makes the image of the actor much smaller, but it will be noticed that he enters from the left and continues his movement toward the right, his goal evidently being the house. Thus by placing two frames from successive scenes side by side it is easy to demonstrate the theory of continuity of movement.

fact, upon which the whole story hangs sometimes, occurs *off the screen.* In describing the play to others we will include such incidents and many there are who would willingly take oath that such action really appeared on the screen. This point leads to many heated arguments among theatre patrons in regard to past productions, for the individual will interpret off-screen action in the terms of his individuality, and this provides a constant source of difference. If all minds worked alike, entrances and exits could be disregarded, but owing to the individual interpretation of off-screen action, the most direct course must be pursued in order that there will be the slightest possible ground for misinterpretation on the part of the spectator and the consequent resumption of screen action be effected with as little shock as possible. Our hero may go from New York to Hong Kong in the interval between two scenes, or in the home-drama, Bob may go from his nursery

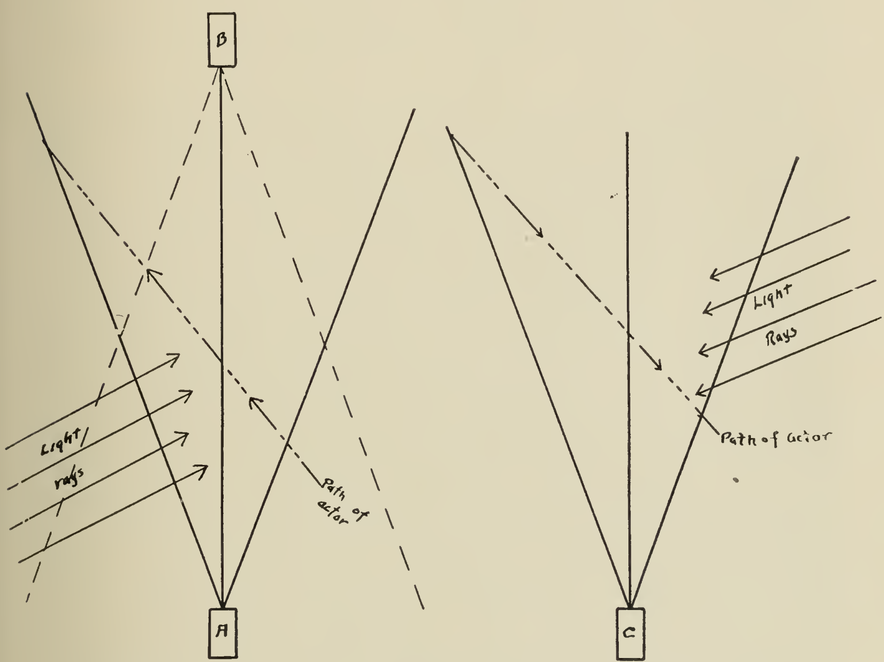
to the neighbor's kitchen. He may run in circles or turn hand-springs while on the screen; but for the preservation of good technique, have each entrance correspond with the preceding exit, and keep him going in a straight line off the screen.



Angular Exits and Reversal of the Point of View. Here we have an apparent disregard of the rule governing entrances and exits, but we have here an angular exit with a reversed point of view for the succeeding entrance. Note that although we have an apparent rupture of the continuity of motion, that in the first frame we see the actor's back while in the succeeding frame we see his face. Note also that the shadows are reversed as indicated by the light-ray arrows. Because it is most confusing in any case this practice should be avoided except when absolutely necessary for the development of the plot. The regular rule should be observed whenever possible. When the point of view is not reversed angular exits and entrances follow the rule. Do not try to reverse the point of view on broadside or straight exits and entrances.

To master this problem you must be able to visualize clearly the scene preceding the one upon which you are working. I do not mean the one which was made just before the one upon which you are working, but the one which will be shown upon the screen just before it, for scenes are not made in chronological order. Suppose that Bob leaves the nursery for the kitchen and leaves by a door at the left side of the room. We next go to the dining room and set up the camera in such a position that he will enter from the right, cross the screen and again leave at the left. Then to the kitchen and set up so that he will again enter from the right. Here he gets his cookie; and as this is a part of the dramatic action at his destination, he may go back and exit at the *right* on his way back to the nursery, and arriving there he will enter at the *left* by the same door used for an exit. This is a complete cycle

of action. The entrances and exits are reversed, but only after action has been completed at the destination, and such action shown unmistakably upon the screen. The return journey is to a limited degree another sequence and entrances and exits are studied for it only, not for the complete cycle. Now suppose that we had set up in the dining room and made our film with entrance and exit reversed. We should feel that Bob had been somewhere doing something unknown to us and was returning, for his direction is reversed. Then if the kitchen shot followed, we should feel that the film was scrambled and the scenes joined out of their proper order, and our interest would be lost.



This diagram illustrates the field as used in making the scenes shown in Plate VI. At point "A" the camera is photographing the actor who follows the path indicated by the dot and dash arrows. The solid arrows indicate the path of light rays. The next "shot" will be to show the corresponding approach of the actor, or the scene as it would be "seen" by the camera were it placed at point "B." The second diagram of this plate shows the set-up for this shot with the camera at "C." Note the reversal of the direction of the light rays which cause a corresponding reversal of the shadows in the picture.

When Bob got his cookie, dramatic action was complete and he might on the contrary, have continued his walk and

have gone out into the yard, in which case, although the dramatic action was completed, it would have been only incidental. The final action would then have taken place in the yard after which the return would have been effected. Try to imagine the result—and I hope you will never see it except in imagination—should Bob leave the screen at the left and in the next scene enter from the left! In technical phrase he is meeting himself. No matter how trivial this sounds in theory, it is most confusing in reality and will inevitably result in the loss of continuity of interest on the part of the spectator. Keep your actors moving in a straight line off the screen unless there is a very good reason for doing otherwise and be sure that if there is such reason it is immediately apparent to your audience.

Off-Screen Vision.—Another closely related subject is that of off-screen vision. This is not the supernatural, dream or trick-vision. It is the registration of some scene or object which lies beyond the limits of the screen, but which is seen by some actor on the screen. That is not very clear. Let us suppose then—to return to our typical baby—that he begins to look frightened. The audience may imagine that he sees a toad or a lion; but if we flash upon the screen a few feet of a huge, gray gander with head and wings outspread, every spectator actually sees this creature rushing upon the baby and they know at once that baby is frightened by the bird. This, despite the fact that in reality the gander may have been photographed a thousand miles away from the baby or that the baby may have never seen such a creature. Your audience sees this action as plainly as though both baby and bird were upon the screen at the same time. For this reason it is advisable to set up the camera so that if baby looks toward the left, the gander is shown rushing to the right. This gives the perfect illusion. An alternative method, used sometimes to create dramatic suspense is to place the camera in the position occupied by the actor and in this case the gander would appear rushing right into the lens. Could we temporarily acquire the mental processes of the baby, this would make a far more impressive scene than would

the first method, but like all forceful elements in photodrama, it must be handled properly and with the utmost attention to detail, otherwise it will not only fail to produce the desired effect, but will also ruin the continuity of interest. For home drama the first method is advised. It is simpler, easier and produces the illusion of perfect continuity.

THE ILLUSION OF COINCIDENCE.— The illusion of coincidence may often be utilized for amusing and startling effects. Leaving baby for the time being, let us go forth and photograph a picnic of young people. They are all seated around the dinner cloth when Bob slyly tickles Mabel's neck with a straw. As a result she probably screams, jumps up and turns around. But, if Bob has been sly enough, there is no apparent reason for this particular bit of business when the picture is shown upon the screen. Then go forth into the woods and fields, or merely into the prosaic woodshed and get a few feet of a huge spider dangling from its gossamer thread. Insert this bit of film into the other, cutting just at the point where she gains her feet and whirls around, and the result will be convincing at least. Your spectators will afterward tell about seeing a picture of a picnic where a great nasty spider dropped right on Mabel's shoulder. Never fear, they will see that which is not. In this work the matching of backgrounds must be carefully done, and the cutting must be exact as explained under the heading "Editing," but in all motion work, the utmost care is necessary. You will now realize that the director must understand the practical application of psychology. In speaking of motion pictures, an old quotation may be aptly paraphrased, "Illusion, illusion, all is illusion."

CROSSING THE LEAD.—Your principal character (or pair of characters in the conventional love plot) must stand out strongly from the other actors. Not only must he not be crossed, but every device such as a contrasting costume, placing him as constantly in the foreground as is possible, and keeping his face constantly toward the camera, must be used to emphasize him. The usual photoplay is merely pantomime enacted by the principal and supported by

minor leads and extras. You may not use these terms, but your home films will be the same, in most cases. Any dramatic theme must have continuity or be lost. This continuity rests upon the shoulders of the leading character. For this reason the suppression of this character means the suppression of the continuity—*unless the specific action demands otherwise.* All action, in so far as is practical, should take place behind this character. Do not let minor characters pass between him and the lens, or in studio parlance, do not let them cross the lead. Of course, this rule is subject to the force of circumstance. Suppose for example, that Mother is the star, supported by the children as minor leads and Rover for atmosphere. Little Jimmy comes running in with a scratched finger and hastens to Mother for comfort. This is tense dramatic action. If he comes in unobtrusively from the rear, passing behind Mother he will appear at her side before the spectators are well aware of his presence on the screen and all of the force of the incident will be lost; but if he comes in pell-mell from a position beside the camera and crosses Mother in his progress the audience is warned that something unusual has occurred and that a dramatic "punch" is coming. By the time he reaches her side they are all prepared for some action of importance. Even to those unfamiliar with the technique of the motion picture, it is at once apparent that any action important enough to warrant crossing the lead and temporarily obscuring all other action on the screen, is action of importance, indeed.

Tempo.—Another point of importance is that of tempo. Tempo, or the rapidity of action, has a marked effect upon the psychological effect of such action. You have all witnessed the tense crowds at a race, barely breathing as the horses come pounding across the line, and the hysterical outburst which marks the let-down after the finish of the race, yet who can imagine any such tense enthusiasm being exhibited at a snail race? Tempo is not amendable to strict rule; but it is usually a natural reaction. Briefly, all action should be somewhat quickened as climaxes are approached, and slowed down to correspond to the relief following the climax. Youth, joy, sport and kindred sub-

jects require a quickened tempo, while domestic scenes, fire-side scenes and idylls should be enacted with action slowed down. Avoid inappropriate action at all times. In real life people neither race to funerals nor walk with lagging steps to a fire.

UNFINISHED ACTION.—Do not use unfinished cross action. This applies to action which has begun before the scene opens, as well as to that which is not completed at the close of the scene. If your actor is walking across the screen, do not open with him halfway across. If you use cross action at all, bring the actor into the scene after it has opened and continue it until he has left the screen. Of course, if the cross action is interrupted by dramatic action, as at the conclusion of a walk, the exit may be disregarded as it might well be inappropriate for the actor to leave the scene. For example, a scene might open empty and two lovers walk into the scene. Then if the dramatic climax is effected here it would be absurd to finish it and have the actors walk off the screen. The proper treatment is to fade out on the embrace. However, the rule applies to the straight cross action. It is also permissible to open on the actor when the action is oblique, that is if the actor is in the distance and advances into as well as across the field. This opening on an actor at the distant end of an oblique cross walk does not jar as it does when he suddenly appears in the middle of the screen and calmly takes up a cross walk. Any scene which shows the progress of an actor from one point to another is termed a walk, no matter if he runs at headlong speed. So, cross walks are very useful in showing the progress of a journey, to establish the fact indisputably that the actor has embarked upon a journey or to show amusing or pertinent facts which occur during the journey. However, if you once begin to follow the actor on his journey, follow him throughout its length and show his arrival at his destination. For example, Johnny leaves the nursery and starts to the kitchen. Then, if you set up in the dining room and show him going through it you must also set up in the kitchen and show his arrival, otherwise you have left him hanging in space, perhaps to become a satellite of the earth, but whatever his

ultimate destination, you have lost the continuity of interest of your audience. If, however, you merely omit the kitchen scene and photograph him upon his return, you have accomplished no purpose, you have him meeting himself and confusion results from the breaking of the rule of entrances and exits. If you don't want to go into the kitchen, wait until he is about to re-enter the nursery and then start your next scene. *He will not meet himself in this case, even though he leaves and re-enters through the same door, for the nursery is the scene of action and a complete cycle of off-screen action has occurred.* He leaves action and exits. He returns and resumes action. Thus, it will be seen that the care necessary with entrances and exits is usually applicable only to walks. The proper calculation of such action is based upon your everyday experience. You may leave a house by the front door, and later you may re-enter by the same door, all in the course of sane and reasonable action, but you seldom walk down the street, then abruptly back again without having reached any destination—unless you have forgotten something—and let me say here, if you should be photographing such a scene, be sure to photograph the sudden hesitation, the thought and the turning and starting back. Don't merely show your actor passing to meet himself, leaving your audience to surmise that he has forgotten something.

This subject of finished action is closely interrelated to that of entrances and exits, yet they are absolutely different. Indeed, some of my readers may think that finished action is that part of the work which sets at naught the rules of entrances and exits, and such is rather near the truth. Let each scene on the screen have definite purpose. Thus, walks show definite progress from one point to another and during its progress entrances and exits should comply with the rule but the beginning or termination of important action occurs in a scene which might be termed a focus of action, and in such all entrances and exits will be such as are the most natural for the action involved. Suppose your setting was a room, the door at the right opening outdoors and that at the left disclosed a bath-

room. Through a window at the rear a beating rain may be seen. The hero dons a rubber coat and steps forth into the storm. It is reasonable and proper for him to re-enter by the same door. If he were to re-enter by the door at the left, according to the rule of entrances, the spectators would not only wonder how he got into the bathroom, but they might also wonder at his unorthodox method of taking a shower. *If not otherwise demanded by the action* it is well, when an actor leaves a focus of action, for him to re-enter by the same door. It indicates a completed cycle, his absence causes no confusion, and his position is immediately identified. Upon reflection you will realize that when you leave the house or room upon one definite errand you usually return through the same door. This is in direct contradiction to the general rule governing entrances and exits, and may prove a bit confusing; but a little thought will show the reason for such contradiction. All of these rules only serve to smooth the way for the spectator. We live in the midst of drama, but it is obscured by the multitude of petty details which fills our lives. The dramatist strips everyday life of such detail and making complexity simple he displays to our sight the pure gold of drama recovered from the dross of life. So remember, the simplest complete action is the best. A pertinent detail here and there helps the general atmosphere at times, but irrelevant detail must be suppressed.

Looking at Camera.—Do not let your actors look into the lens of the camera. The screen often displays the most intimate action. Action which we should not commonly have the opporunity to observe in real life. The position of the spectator is analogous to that of the spy. He sees the most private action, but by a peculiar psychological reaction, his personality is merged with that of one of the leading characters, so the impropriety of peeping is not felt. If, however, the actor looks into the lens, he looks directly into the eyes of each individual spectator in the audience. This breaks the illusion of merged personality and brings home the feeling of being caught in the act of spying upon the private life of our neighbors. Suppose you were watching a man through a powerful telescope

so far distant from him that you know he cannot see you. You are perfectly comfortable as long as he looks away, but let him look directly at you and you will feel uncomfortable, even though you know he cannot distinguish you.

This rule is broken often, especially in the large studios where actors and actresses of proved ability are employed. It is also used by some news men in photographing figures of importance. In the studio it is most often used in connection with the closeup to register intense emotion, and in the resulting surge of emotion in the audience, the guilty feeling is lost. The newsman is photographing events of the most public nature, and if he can get a film of the President looking directly into the lens he has obtained a film which when projected will give to each spectator a most delightful sense of intimacy with the head of our nation, for on the screen the President looks directly into the eyes of each spectator, and he feels that he has in a measure had a direct conversation with the chief executive. So, the rule may be transgressed in order to create a sympathetic reaction among the audience, but it is a dangerous business in drama, and I would advise the amateur to avoid it.

A volume could be filled with rules, but those given will serve to guide the way, and the fewer rules which can be used, the more artistic will be the result. Many directors have certain methods of procedure which are not observed by others, but these are idiosyncrasies and to follow them would result in an imitation of the technique of that particular director, and as most imitations are, it would be a weak, washed-out thing.

It is best for the amateur cinematographer to start with a very few actors in his productions. Anyone familiar with any phase of camera work knows that the instant anyone sees a camera pointed at him, he begins to pose, consciously or otherwise. This is ruinous in motion work, and upon the shoulders of the cinematographer rests the responsibility of seeing that the action is at all times spontaneous, or at least, apparently so. This means, of course, that all actors must be watched constantly; and at the first hint of stiffness, be warned against it. For the begin-

ner to try to make a film with a dozen actors or so on the screen at one time, none of whom have ever had screen-acting experience, is to court disaster. The effort of trying to keep all of them acting smoothly will confuse the cinematographer. Then he will neglect some while trying to correct others, and the camera had better be stopped.

LENGTH OF SCENE.—In this connection it might not be amiss to mention the length of scenes. It is apparent that the longer the action, the more difficult it is to keep all going smoothly. You may easily walk a dozen steps with an armload of boat oars on your shoulder, but try to carry them a hundred yards and you will have trouble. The usual action outlined by the amateur will run from one to five minutes, dull, slow, monotonous and filled with superfluous detail. Boil it down! Retain only the meat of the scene! It is an unusually important scene, even in professional work which runs for a minute on the screen. The writer can count upon the fingers of one hand all of the times he has seen a professional scene of such length! Go to the theatre and time the scenes. You will be amazed to find the number of scenes of twenty, fifteen seconds, and less. Keep your scenes "peppy." Just as verbosity ruins a story, so excess footage ruins a film. Remember that the bulk of the action takes place off the screen, in point of time at least, and you show only enough of the highlights, so to speak, to enable the spectator to follow the continuity. When you go to the theatre, calculate the time covered by the story. The film will probably be in less than ten reels. In this case you have witnessed action in natural tempo, lasting two hours and forty minutes, yet the dramatic time elapsed may be from six hours to ten thousand years. Two hundred feet of sixteen millimeter film, is ample to photograph a complete and interesting home playlet with a screen time of eight minutes. Now wait a minute! Sit down and time eight minutes by your watch before you express your disgust. A cinematographic minute has sixty full seconds in it, each an appreciable interval of time.

I shall now mention two more points, far more professional in character, with the hope that the advanced ama-

teur will incorporate them in his home dramas to their infinite betterment. These two points are the closeup and the fades, both very common, in fact there is rarely a professional motiograph made which does not include both. They are, however, difficult to master, and must be used properly or the photo-play would be better without them.

THE CLOSE-UP.—The close-up, a discovery attributed, I believe, to D. W. Griffith, is practical only when using an actor who is capable of registering emotion in a most convincing manner, or when using a character actor who is a past master in the use of make-up and facial expression. In close up work every bit of skill which the cinematographer possesses is called upon, and the make-up must be perfect. Motion film cannot be retouched and the lens does not flatter. The close-up is only appropriate in the display of the stress of emotion and in emphasizing action which is so subtle that it might not otherwise be appreciated. It is evident that such work requires a finished actor, the only others who provide satisfactory close-ups are infants who are too young to be self-conscious and the lower order of animals. They may, of course, be used for home portraiture, and as such will provide invaluable *records* for future reference, but in dramatic action, they may as a rule, be dispensed with in the home playlet. However, if you are filled with true amateur enthusiasm, and have an actor, or actress, whom you believe to be competent, go ahead! Success adds immeasurably to the home film as well as to the professional variety.

Do not confuse the close-up with the insert. The insert is a close-up of a letter, a knife or other inanimate object which serves to call the attention of the audience unmistakably to the object in question, so its connection with later developments may be understood.

This brings up the question of semi-close-up, medium shot, full shot, medium long shot, long shot and so forth. There is no set rule for these terms, which are used by professionals to give merely a general idea of the action involved. I heard one cameraman give the following rules:

Close-up	cut at shoulders;
Semi-close-up	cut just above waist;
Medium shot	cut at knee;
Full shot	cut to include feet;
Medium long shot.........	vertical dimensions of frame three to five times as high as an adult;
Long shot	to include buildings in their entirety.

It will be seen that even such a set of rules must be very elastic, and are but vague at best. They may be convenient for the amateur in conversation, but in practice, common sense is the best guide, and the shot may be called by any name. A full shot by any other name will look as good. Set your camera to include the desired action without crowding and "shoot." If you desire to photograph an animated conversation, cut the actors at thigh or waist if you choose,—people now-a-days don't talk with their toes. But a dancer, cut at the knees, would be absurd. Use common sense. Don't try to include the whole universe. Get important action and let the rest take care of itself.

This chapter might go on indefinitely, but there is a limit to the space available and to the patience of my readers. It is to be hoped that the salient points of direction as applicable to the amateur have been covered at least to such an extent that the details may be worked out easily. The chapter may seem to be unnecessarily professional in character, but all points mentioned are just as applicable to the modest home drama as to the professional, multiple reel spectacle. As I have said these rules are not as the laws of the Medes and the Persians. They are more nearly guide posts which may point the way around pitfalls. If they have been found to improve the quality of professional photo-dramas does it not seem logical to suppose that they will improve the home-drama? I have used the terms "actor," "drama," "cinematographer," "director" and other technical phrases. This does not imply that the home-drama should be an attempt at romance or adventure. Any person being photographed by a motion picture camera is essentially an actor. Any action

worth photographing, no matter how simple, has dramatic elements. Likewise, the man who manipulates a motion picture camera is a cinematographer; and if he instructs his actors he is also a director. The terms are convenient—they do not deal with strange facts. We have all been actors at some time or another—either that or some of my readers are more sincere than any person it has been my good fortune to meet.

CHAPTER TWENTY-ONE

THE PRODUCTION AND USE OF FILM SLIDES

This is not, strictly speaking, a phase of amateur cinematography, but as it is in many ways quite similar, and as it involves many of the operations common to cinematography, and finally as it is so appropriate as a supplemental feature of an evening's projection, it is not out of place to give a little space to this new and fascinating work.

Film slides are individual still pictures, made usually upon standard gauge motion picture film, for projection without motion. The whole argument in favor of film slides is exemplified in the case of the traveller. "Why waste from thirty to fifty feet of motion picture film upon a landscape, when a far more beautiful reproduction can be obtained at a cost of less than five cents?" There can be no question but what the motion picture camera of the traveller, the vacationist, the sportsman, the explorer and of the cinematographer in general should be supplemented by a single exposure film camera.

There are a number of these cameras on the market. The Ansco Memo is a box camera using standard motion picture film, and making individual photographs 1 x ¾ inch or 18 x 24 millimeters. These pictures may be easily enlarged up to post card size. This camera is small and easily carried, and has proven to be quite popular.

The original camera used for this purpose is the Sept. This is an automatic, spring driven camera which may be set to make motion pictures, still snaps or time exposures. It is fairly heavy, but gives pictures of the usual standard movie frame size, 18 x 24 millimeters, of exquisite definition.

The Ernemann line of miniature cameras include both box and folding types, the folding cameras resembling vest pocket cameras but somewhat smaller in size. For these cameras, a full line of accessories are available, such as printers for both paper and film positives, enlargers, developing tanks and racks and other necessary items.

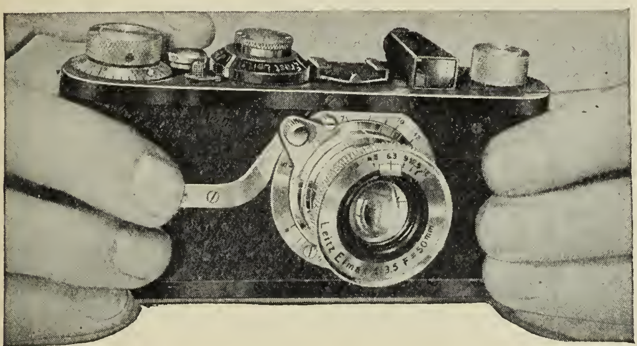
The projectors offered for this work are capable of throwing a full 7 x 9 screen image with full brilliance. There are many types of these projectors including the Ernemann Bobette, the Brayco and others. The Wyko is probably the outstanding projector of this type. It has a powerful projection bulb and a fine, large aperture lens. It will give a full 9 x 12 image. This projector is automatic in that it is operated, that is the film is advanced, frame by frame by a remote electrical control. This makes the machine very valuable for demonstration work such as classroom work. Another feature of this machine is that the film does not have to be rewound for exhibition. The film is fed from the center of the roll and taken-up in the same order as the film in the retort.

Screen pictures may be obtained which are in every way equal to those obtained by the use of glass slides. They may be toned, hand tinted or otherwise treated as glass lantern slides are treated. The great objection to the lantern slide was the weight, cost and fragility of the slides; the weight and size of the projector. Fifty glass slides, in their case, would weigh ten or twelve pounds, and would occupy two or three cubic feet of space. The same thing on film, that is a series of positives which will give identically the same effect upon the screen would weigh perhaps an ounce, and could be carried in the vest pocket, occupying less than one cubic inch of space. In fact, the fifty pictures would require three and one-eighth feet of standard gauge, 35 millimeter motion picture film.

So practical and so efficient has this process been found to be that it is rapidly replacing the glass slide in all kinds of work. In view of this fact manufacturers of stereopticons have introduced auxiliary apparatus for converting the usual type of slide projector into a film-slide projector, while the Spencer Lens Company have introduced a special model of their "Delineascope" for this work.

There is but one objection to this type of camera. The negatives, while all right for projection are not large enough for direct prints or paper enlargements of satisfactory size. In order to overcome this defect a complete set of apparatus including camera, enlarger, printer, projector and other accessories has been introduced. This equipment makes a picture the size of two standard frames, 1 x 1½ inches or 24 x 36 millimeters in size. This is the Leitz Leica equip-

ment. The camera is smaller than the smallest vest pocket camera, yet it is equipped with a self capping focal plane shutter with speeds from 1/20 to 1/500 second as well as time. It holds sufficient film for 30 exposures in a metal magazine which can be easily changed when the film has been exposed. The camera alone can be carried in the vest or trousers pocket without being noticeable. The complete outfit of camera, two extra magazines in container and distance meter come in a leather carrying case which can be swung beneath the coat or carried in a coat pocket, without inconvenience.



(*Courtesy E. Leitz, Inc.*)

The Leitz Leica Camera

The lens is a 2 inch, f 3.5 of such correction that flawless paper enlargements up to 8 x 10 may be easily secured. This lens is mounted in a micrometer focussing mount graduated from infinity to 1½ feet.

This camera is the most exquisite, most efficient and most practical camera made for the photographer who must economize in bulk and weight.

As this camera is used in both vertical and horizontal positions, the film carriage of the special projector is made to swing so that vertical and horizontal pictures may be alternated upon a single film and projected without any difficulty. This is a feature of prime importance, as it allows much better composition of some subjects.

The printing machine is about the same size and very similar in appearance to the camera. It is arranged to print the film negatives upon a roll of paper, but in this work the film may be moved independently of the paper making selection possible.

The enlarger is of the usual vertical type and has a diffused light which makes it possible to enlarge scratched film giving an enlargement which, while sharper in every photo-

(*Courtesy E. Leitz, Inc.*)
Actual size of Leica Print with an enlargement from same negative.

graphic detail than the usual enlargement, is free from scratch marks. This is something which has not before been satisfactorily accomplished.

The camera may also be equipped with a supplementary

lens which makes possible the reproduction of objects from about 4 x 6 inches down to about 2 x 3, the object in each case filling the negative. There are some sixteen variations of size possible, corresponding to the focussing mount calibrations. For use with this lens a folding stand has been made which enables the photographer to make photographic copies of pages of books without difficulty. An ordinary book of 250 pages may be photographed upon 31 feet of film, which makes a roll of about 1⅜ inches long by one inch in diameter, each negative being capable of being enlarged to twice the original size of the book. The stand is also suitable for making large scale copies of various small objects, such as jewelry, stamps, insects, etc.

Thus, serving, as it does, to produce paper contact prints, enlargements up to 8 x 10, positives on film for projection and copying, this camera, despite its small size, is more truly universal than any camera heretofore introduced—because with all of these possibilities, the instrument itself may be carried in a pocket without discomfort. It forms a logical part of the traveller's equipment and supplements the motion camera in many ways.

Single frame positive films may be hand tinted very easily and in this way the screen effect is greatly improved. In fact by tinting, toning and coloring these single frame pictures, they may be made considerably more attractive than the same inanimate scene made upon motion film.

PART THREE

Appendix

APPENDIX

FILTERS: THEIR USE AND FACTORS.

Filters are pieces of colored glass used to hold back the excessive ultra-violet and violet rays, allowing the less active yellow and green rays time to act. The result is a more truthful tonal rendering, with a toned sky and cloud effects. As clouds enhance the beauty of any outdoor scene to such an extent, it is always better to retain them if possible. The 2x and 3x filters will usually do this.

Filters are known, in amateur cinematography, as 2x, 3x and 4x. This means that used with the usual 16 millimeter emulsion the time of exposure is increased two, three or four times. In using the Dremophot, the compensating time is indicated, the speed factor 32 being used for a 2x, 48 for the 3x and 64 for the 4x filters, but for the benefit of those who do not have this meter the following table is given. In each table the upper row of figures indicates the usual stop as given by the exposure meter or as determined visually. The lower row indicates the actual stop used on the camera with the filter named. This table does not show exact multiplication of the "f" values but is changed to indicate the nearest usual calibration. The amount of error will not noticeably affect the film.

FOR 2x FILTER.

Meter	1.5	1.9	2.0	2.5	2.7	3.0	3.5	4.0	4.5	5.6	6.3	8.0	11.0	16.0
Use	....	....	1.5	1.8	1.9	2.0	2.5	2.8	3.5	4.0	4.5	5.6	8.0	11.0

FOR 3x FILTER.

Meter	1.5	1.9	2.0	2.5	2.7	3.0	3.5	4.0	4.5	5.6	6.3	8.0	11.0	16.0
Use	....	....	....	1.5	1.5	1.8	2.0	2.2	2.6	3.0	3.5	5.6	6.3	8.0

FOR 4x FILTER

Meter	1.5	1.9	2.0	2.5	2.7	3.0	3.5	4.0	4.5	5.6	6.3	8.0	11.0	16.0
Use	....	....	....	....	....	1.5	1.8	2.0	2.2	2.7	3.0	4.0	5.6	8.0

The tremendous value of the f 1.9 and f 1.5 lenses are shown here, as with the slower lenses filter work is greatly limited.

PROJECTING FORMULAE.

There are often cases when one wishes to know various facts concerning the projection of amateur films and in most

cases when the question concerns image size, focal length of lens and so forth, the following formulae may be used to advantage.

We assign arbitrary symbols to the factors involved in such calculations as follows: The throw, or the distance between projector and screen "T", the width of the image

FOCAL LENGTH of LENS (INCHES)	8	10	12	16	20	25	32	36	40	45	50	64	75
	FIGURES AT HEAD of COLUMS INDICATE DISTANCE BETWEEN SCREEN and PROJECTOR IN TABLE UPPER FIGURES INDICATE WIDTH OF SCREEN — LOWER FIGURES INDICATE HEIGHTH												
1	3.08 2.28	3.85 2.85	4.62 3.42	6.16 4.56	7.70 5.70	9.63 7.13	~	~	~	~	~	~	~
1½	2.05 1.52	2.57 1.90	3.08 2.28	4.11 3.04	5.13 3.80	6.42 4.75	8.21 6.08	9.24 6.84	~	~	~	~	~
2	1.54 1.14	1.93 1.43	2.31 1.71	3.08 2.28	3.85 2.85	4.81 3.56	6.16 4.56	6.93 5.13	7.70 5.70	8.66 6.41	9.63 7.13	~	~
2½	1.23 .91	1.54 1.14	1.85 1.37	2.46 1.83	3.08 2.28	3.85 2.85	4.93 3.65	5.54 4.10	6.16 4.56	6.93 5.13	7.70 5.70	9.86 7.30	~
3	~	1.28 .95	1.54 1.14	2.05 1.52	2.57 1.90	3.21 2.38	4.11 3.04	4.62 3.42	5.13 3.80	5.77 4.28	6.42 4.75	8.21 6.08	9.63 7.13
3½	~	1.10 .81	1.32 .98	1.76 1.30	2.20 1.63	2.75 2.04	3.52 2.60	3.96 2.93	4.40 3.26	4.95 3.66	5.50 4.07	7.04 5.21	8.25 6.11
4	~	~	1.16 .86	1.34 1.14	1.94 1.43	2.41 1.73	3.00 2.28	3.47 2.57	3.85 2.85	4.35 3.21	4.82 3.57	6.16 4.56	7.22 5.35

COURTESY BELL & HOWELL Co.

Table of screen sizes at various distances with various lenses.

upon the screen we call "D", the focal length of the lens is indicated by "F" while the frame size is designated by "A".

In these formulae "A" will always have a value of 10.5 in millimeters or approximately .4 inch.

When we wish to know the focal length of a lens used in our projector we make use of this formula:

$$F = \frac{T}{D} \times A$$

When we know the distance and the focal length and wish to determine the width of the picture which will be projected we make use of this formula:

$$D = \frac{T}{F} \times A$$

And finally when we know the distance between the screen and the projector and the width of the picture upon the screen, and wish to know the focal length of the lens used we find that

$$F = \frac{T}{D} \times A$$

With one or the other of these formulae we are enabled to perform almost any calculation which may arise in connection with the optical factors of projection.

SIZE OF FIELD INCLUDED BY VARIOUS LENSES AT VARIOUS DISTANCES.

The question often arises, "Just what can I get in my picture at a distance of fifty feet?" or "How far away must I get to make a full length shot of a man six feet tall?" The most obvious answer is, "Take the camera out and find out." This is the answer of the haphazard, casual film-snapper. The serious amateur needs just this information in order to plan his shots. It is obvious that no definite answer can be given to these questions unless we know the focal length of the lens used. In addition to this, information concerning the included angle of the lens will be of great service in laying out the lines for amateur production and in planning sets.

Through the courtesy of the Bell & Howell Company, we are enabled to give this information in a concise, ready reference table, which is printed upon the opposite page.

The ciné camera, it must be remembered, always makes a horizontal picture. For this reason we have two measurements for each lens and distance. These two are the horizontal field included, and the vertical field included. These two measurements are indicated by the letter "H" for horizontal and "V" for vertical. As the position of the lens is fixed as is any given distance, it will be seen that these two measurements form the bases of two dissimilar triangles, so it follows that we have two angular measurements, one for each field. It will be noted that neither of these angles is the true effective angle of the lens, for this angle takes the diagonal of the field (or negative frame) as its base.

All distances are given in feet, including the measurements of the fields. The multiplication factor for reducing this to inches is given immediately below the table.

This table is based upon the normal included angle of the lenses and does not take into account the decrease in the angle (and field) due to increasing the distance between the

Focal Length of Lenses	Plane	Angle	1	1.5	2	3	4	5	6	7	8	15	25	30	40	50	60	75	100	150	200	300	400	500	1000
			Size of Included Field of Lens When Focussed Upon A Point At Infinity • Decreased Angle With Lengthened Back Focus Disregarded. Distance from camera in feet																						
20 m/m	H	26°-4'	.49	.73	.98	1.5	2.0	2.4	2.9	3.4	3.9	7.3	12.2	14.7	19.5	24.4	29.3	36.7	48.9	73.3	97.8	146	195	245	489
	V	19°-54'	.36	.54	.72	1.1	1.4	1.8	2.2	2.5	2.9	5.4	9.0	10.9	14.5	18.1	21.7	27.1	36.2	54.3	72.4	108	144	181	362
25 m/m	H	21°-22'	.39	.59	.78	1.2	1.6	2.0	2.3	2.7	3.1	5.9	9.7	11.7	15.6	19.5	23.5	29.3	39.1	58.7	78.2	117.3	156	195	391
	V	16°-9'	.29	.43	.58	.87	1.2	1.4	1.7	2.0	2.3	4.3	7.2	8.7	11.6	14.5	17.4	21.7	28.9	43.4	57.9	86.9	116	145	290
35 m/m	H	15°-37'	.28	.42	.56	.84	1.1	1.4	1.7	1.9	2.2	4.2	6.9	8.4	11.2	13.9	16.8	20.9	27.9	41.9	55.8	83.8	112	140	280
	V	11°-41'	.21	.31	.41	.62	.83	1.0	1.2	1.4	1.6	3.1	5.1	6.2	8.3	10.3	12.4	15.5	20.7	31	41.3	62	82.7	103	206
50 m/m	H	11°-4'	.19	.29	.39	.59	.78	.98	1.2	1.4	1.6	2.9	4.8	5.9	7.8	9.8	11.7	14.6	19.5	29.3	39.1	58.7	78.2	97.8	195
	V	8°-4'	.14	.22	.29	.43	.58	.72	.87	1.0	1.1	2.2	3.6	4.3	5.8	7.2	8.7	10.8	14.5	21.7	28.9	43.4	57.9	72.4	145
3 Inch	H	7°-20'	.13	.19	.26	.38	.51	.64	.77	.90	1.0	1.9	3.2	3.8	5.1	6.4	7.7	9.6	12.8	19.2	25.7	38.5	51.3	64.2	129
	V	5°-26'	.09	.14	.19	.28	.38	.47	.57	.66	.76	1.4	2.4	2.8	3.8	4.7	5.7	7.1	9.5	14.2	19.0	28.5	38	47.6	95
3¾ Inch	H	5°-52'	.10	.15	.21	.31	.41	.51	.62	.72	.82	1.5	2.6	3.1	4.1	5.1	6.2	7.7	10.3	15.4	20.5	30.8	41.1	51.4	103
	V	4°-21'	.07	.11	.15	.23	.30	.38	.46	.51	.61	1.1	1.9	2.3	3.0	3.8	4.6	5.7	7.6	11.4	15.2	22.8	30.4	38.	76
4 Inch	H	5°-30'	.10	.14	.19	.29	.38	.48	.58	.67	.77	1.4	2.4	2.9	3.8	4.8	5.8	7.2	9.6	14.4	19.2	28.9	38.5	48.1	96.2
	V	4°-5'	.07	.11	.14	.21	.28	.36	.43	.50	.57	1.1	1.8	2.1	2.8	3.5	4.3	5.3	7.1	10.7	14.2	21.3	28.5	35.6	71.2
6 Inch	H	3°-40'	.06	.09	.13	.19	.26	.32	.38	.45	.51	9.6	1.6	1.9	2.5	3.2	3.8	4.8	6.4	9.6	12.8	19.2	25.7	32	64
	V	2°-43'	.05	.07	.09	.14	.19	.24	.28	.33	.38	.71	1.2	1.4	1.9	2.4	2.8	3.5	4.7	7.1	9.5	14.2	19	23.7	47.5

Multiplying Factors For Inch Equivalents. 1 foot = 12 inches 0.1 foot = 1.2 inches 0.01 foot = 0.12 inch Example: 0.38 foot = 38 × 0.12 = 4.56 inches

Courtesy - Bell & Howell Co.

Table showing included field of various lenses, and at various distances.

lens and the film which takes place in focusing upon very near objects. Thus, in the last case, the 6 inch lens at 1 foot. When this lens is focussed at approximately infinity, the rectangle cut by its included angle is about .06x.05 foot, but when focussed at 1 foot this is 7.5mmx10.5mm.

DEPTH OF FIELD.

When working with cinematographic lenses it is often quite essential to know the depth of the field, that is those distances which represent the nearest and farthest points which an object can occupy and still be in sharp focus. The depth of this field decreases as the object approaches the lens.

TABLE OF HYPERFOCAL DISTANCES.

FOCAL LENGTH OF LENS	RELATIVE APERTURE OR THE "f" NUMBER OF THE DIAPHRAGM STOP USED.											
	1	1.5	2	2.8	3	3.5	4	4.5	5.6	8	11	16
1 INCH	41.6	27.75	20.80	15.20	13.87	11.90	10.40	9.25	7.60	5.20	3.80	2.60
1½ INCH	93.8	62.4	46.88	34.00	31.20	26.8	23.44	20.8	17	11.72	8.5	5.86
2 INCH	116.4	111	83.2	60.8	55.5	47.6	41.6	37	30.4	20.8	15.2	10.4
3 INCH	395	249.6	197.5	136	124.8	107.2	93.76	83.2	68	46.88	34	23.44
3¾ INCH	587	390.6	293.4	213	195.3	167.4	146.7	130.2	106.5	73.34	53.25	36.6
4 INCH	665.5	444	332.8	243.2	222	190.4	166.4	148	121.6	83.2	60.8	41.6
4½ INCH	844.6	561.6	422.3	306	280.8	241	211.2	187.2	153	105.5	76.5	52.7
6 INCH	1500	998.4	750	544	499.2	428	375	332.8	272	187.5	136	93.75

Table of hyperfocal distances.

Before making this determination, the hyperfocal distance of the lens and stop used must be determined. This value is represented by the symbol H in the following formulae. Other symbols are: F— focal length of the lens used; Ra—Relative aperture; C—diameter of largest permissible circle of confusion and X—any unknown factor.

$$H = \frac{F^2 \text{ x } C}{Ra}$$

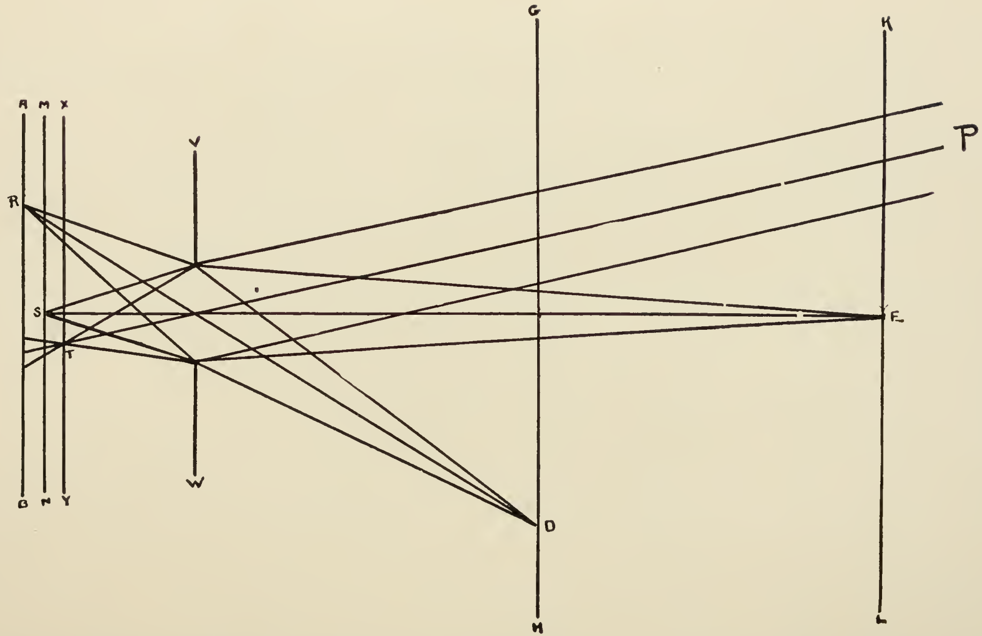
If we focus upon infinity the nearest object in sharp focus lies at a distance equal to H.

If we focus upon an object at the distance H (more exactly H + F) all objects from $\frac{H}{2}$ to infinity are in focus.

EXAMPLES—*in which F = 2; Ra = 4 and C = .01 inch.*

$$H = \frac{2 \text{ x } 2 \text{ x } 100}{4} = \frac{400}{4} = 100 \textit{ inches or } 8 \textit{ feet, } 4 \textit{ inches.}$$

THEN, *if we focus upon infinity, all objects from 8′ 4″ to infinity are in sharp focus, the nearest object in sharp focus lying at a distance of 8′ 4″.*



We have three rays of light coming from points to the lens. Ray P comes from a point in an object far distant, E from a point in an object fairly near the lens and D comes from a point in an object very near the lens. These three rays come to foci in three different planes, P is focussed in plane XY, E is focussed in plane MN while D is focussed in plane AB. We see that if we place the film in plane MN both P and D will be reproduced, not as points but as circles of confusion. In this we start with the largest permissible circle of confusion and we move plane MN away from plane XY until ray P is represented by a circle of this predetermined size. This fixes the position of plane MN. We then move plane AB away from MN until it is just as far from MN as AB is. Under these conditions we find that objects sharply focussed in plane MN are at a definite distance from the camera. This distance we call the *hyperfocal distance.* We also find that objects sharply focussed in plane AB are just one-half as far from the lens as those focussed in plane MN. As the distance between AB and MN is the same as that between MN and XY it follows that the circles of confusion of ray P and D are equal in size. We see then that the *hyperfocal distance is the distance of the nearest object which can be focussed upon sharply while having objects at infinity focussed with satisfactory sharpness.*

ALSO *if we focus upon an object lying distant* 8′ 4″, *then everything lying between* 4′ 2″ *and infinity will be in sharp focus.*

HOWEVER, *with the usual values,* $F = 2$; $Ra = 3.5$ *and* $C = 0.002''$ (1/500*th inch*) $H = \dfrac{2 \text{ x } 2 \text{ x } 500}{3.5} = \dfrac{2000}{3.5}$ $= 571$ *inches or* 47.5 *feet. The greatest difference between this and the foregoing example being the diameter of the largest permissible circle of confusion.*

If we focus upon an object which is nearer to the camera than the hyperfocal distance, we encounter an entirely new problem, inasmuch as we must determine the maximum limit as well as the minimum. When we focus for a distance less than H, objects at infinity are no longer in focus.

If we focus upon an object at the distance X, the distance of the nearest object in focus is $\dfrac{H\,X}{H + D}$ while the farthest object in sharp focus lies at a distance which is equal to $\dfrac{H\,X}{H - D}$

Here we have a new factor "D". D is equal to X minus F. However, when the distance X is equal to 25 focal lengths or more, the factor D may be disregarded and X used in its place. Thus for such distances the depth extends from $\dfrac{H\,X}{H + X}$ to $\dfrac{H\,X}{H - X}$

As H is a definite factor, X should be expressed in the same units at H. Thus if H is expressed in feet, then X must be expressed in the same manner.

EXAMPLES: *What is the depth of field when the* 2″, *f* 3.5 *lens is focused at* 3 *feet?* $\dfrac{47.5 \text{ x } 3}{47.5 + (3 - 1/6)}$ *to* $\dfrac{47.5 \text{ x } 3}{47.5 - (3 - 1/6)}$ *equals* $\dfrac{142.5}{49.434}$ *to* $\dfrac{142.5}{44.666}$ *equals* 2.88 *to* 3.19 *in which case we have a depth of field of* 0.31 *feet or roughly four inches. In this case it is essential that the factor D be used.*

EXAMPLE: *What is the depth of field if the* 2″, *f* 3.5 *lens is focused at* 25 *feet?* $\dfrac{47.5 \text{ x } 25}{47.5 + 25}$ *to* $\dfrac{47.5 \text{ x } 25}{47.5 - 25}$ *equals* $\dfrac{1187.5}{72.5}$ *to* $\dfrac{1187.5}{22.5}$ *equals* 16.3 *to* 52.8 *feet, in this case D is*

disregarded and X is used instead, as the distance X is more than 25F.

DEPTH OF FIELDS OF TWO DISSIMILAR LENSES:

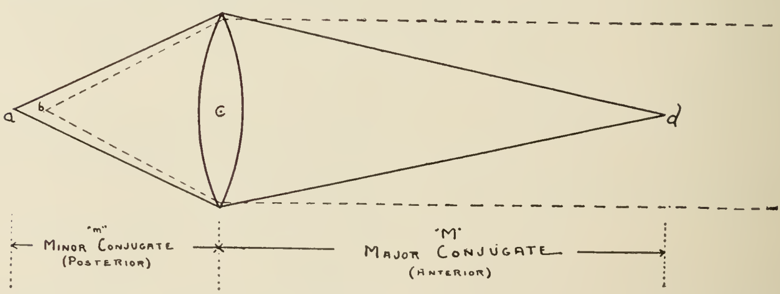
For equal depth the Ra of the lenses must vary in proportion to the *squares* of F.

DEPTH IN ENLARGEMENT SUCH AS IN PROJECTION OR PROJECTION PRINTING:

Given: An image formed by a lens of known aperture (Ra) and focal length (F). This image is enlarged X times. The result has the *size* and the *depth* of an image formed by a lens whose aperture is RaX and whose focal length is FX.

EXAMPLE: *The image from a 2″, f 4 lens is enlarged six diameters. It is then equal to the image formed by a lens of 12″ (6 x 2) focal length at f 24 (6 x 4).*

ALSO, *The image from a 1″, f 3.5 lens (usual 16 mm. ciné lens) is thrown upon a screen 1050 millimeters (approx. 40″) wide, the image is equivalent to that from a lens of 8.33* FEET *focal length at an aperture of f 350! This accounts to a great extent for the remarkable results obtained in motion picture projection.*



Conjugate foci. The broken lines indicate the path of a ray of light from a great distance. The solid lines indicate the path of a ray from a nearby object. This ray is focussed at a greater distance from the lens than the first ray. Thus we have two factors, the distance from the center of the lens to the object which we call the Major or Anterior conjugate and the distance from the center of the lens to the screen as the Minor or Posterior conjugate. In the above figure the distance "ac" is the Minor conjugate while the distance "cd" is the Major conjugate.

CONJUGATE FOCI.

There are times when we wish to make a negative image which has a definite size relation to the original—and want to know the lens setting to secure this ratio—at times we wish to know the lens extension when the lens is focussed upon some object less than the hyperfocal distance, and

when this distance is known. In short there are many occasions when we wish to know certain facts which are concerned with the front focus, back focus and ratio of image to original size. These things may all be determined through the use of the formulae based upon the conjugate foci.

We are all familiar with the path of light rays through a lens. We know that from a single point in the object the rays spread until they cover the entire lens, then they are converged by this lens and meet at a common point or "focus" behind the lens. Thus in the diagram we have "d", a point in the original object, "a", a point in the sensitive surface or film, the point of focus. Now the distances ac and cd form the conjugate foci, ac being the posterior or minor focus while cd in the anterior or major focus, represented respectively by m and M.

This gives us these factors:

$m = F + (F/R)$ Also $M = F + (FR)$

Then it follows:

$$mR = M \quad \text{also} \quad m = M/R.$$

EXAMPLES:

1. *Given a six inch lens. A negative image* ¼ *natural size is to be made. (R then* = 4*).* $m = F + (F/R) = 6 + 6/4 = 6 + 1\frac{1}{2} = 7\frac{1}{2}$. *Minor conjugate equals* 7½ *inches.* $M = F + FR = 6 + (6x4) = 6 + 24 = 30$. *Major conjugate equals* 30 *inches. Therefore the lens extension is* 7½ *inches and the object placed* 30 *inches from lens.*
2. *A six inch lens is focussed upon an object* 10 *feet (*120 *inches) away. Find m and R.* $M = F + FR$. *Then* 120 *(M)* = 6 *(F)* + 6*R, or* 120 — 6 = 6*R, or* 114 = 6*R or* 19 = *R. Also* $m = M/R$ *or* $m = 120/19$, *or* $m = 6.313$ *inches the minor conjugate. Then, when the six inch lens is focussed at* 10 *feet, the extension is* 6.313 *inches and the image formed is* 1/19*th natural size.*

TO REPRODUCE OBJECTS UPON THE SCREEN IN ANY DESIRED PROPORTION TO THE ORIGINAL SIZE.

It is often desirable, particularly in scientific work, to be able to reproduce upon the screen an image whose size bears

a definite ratio to the size of the original. In such cases it is evident that the screen size must be constant. Any combination of projector lens and projection distance may be used which gives this constant screen size. If a different screen size is used, it is evident that a new computation must be made.

This calculation makes use of the formulae given under "Conjugate Foci."

The frame size of the 16 millimeter film is 10.5 millimeters, in width. The first step is to determine the value of R′, the ratio existing between screen size and frame size. The width of the screen in millimeters divided by 10.5 gives this value. (The width in inches is multiplied by 25.4 and divided by 10.5 to give this value, or directly by multiplying the screen width in inches by 2.42, which is nearly enough correct.)

The factor r is the ratio existing between the size of the original and the screen size.

Then it may be seen that R, the ratio between original and frame size equals R′/r.

EXAMPLE: *With a* 40 *inch screen, and with a* 1 *inch camera lens we wish to project a life-size image.*

In this case $r = 1$. *Then* $R = R'/1$ *or simply* R'.

Then as $40 \times 2.42 = 96.8$, R' *must also equal* 96.8 *and consequently* R *equals* 96.8.

We have seen that $M = F + (FR)$ *or in this case* $M = 1 + 1 \times 96.8$ or 97.8 *inches.*

In this case the object is placed 97.8 *inches or* 8 *feet,* 8.8 *inches from the camera.*

GIVEN: *A* 2 *inch lens on the camera to project a double size image on a* 1050 *millimeter screen.*

$R' = 100$ *and* $r = 2$. *Then* $R'/r = 50$. *Then* $R = 50$. *As* $M = F + (FR)$, *then* $M = 2 + (2 \times 50)$; $M = 2 + 100$; $M = 102$.

M equals 102 *inches or eight and one-half feet, the distance of object from camera. We can readily understand that if the ratio of original to film size is* 1 : 50 *and the film to screen size is* 1:100 *the image will be double natural size.*

GIVEN: *same conditions to make a half size image.*

$R' = 100$ *and* $r = 0.5$. *Then* $R'/r = 200$ *and* $R = 200$. *Then* $2\ (2 \times 200) = 402$ *inches or* 33.5 *feet, the distance of the object. Here as the film image is* 1/200 *original size*

and this is enlarged 100 *times in projection we have* 100 x 1/200 *equals* ½ *original size.*

VARIATION IN RELATIVE APERTURE WHEN WORKING WITH VERY NEAR OBJECTS.

It is quite often necessary to work with objects comparatively near the lens, and when this distance is less than ten focal lengths, the extension of the lens is such that the values of the relative apertures (f numbers) marked upon the iris ring are no longer correct. If the work in hand is of such nature that a correct exposure is necessary, without any variation, the true relative aperture must be computed.

We have seen that $M = F + (FR)$, also that $mR = M$. This enables us to find the absolute value of the minor conjugate m, or as we might state it the true lens extension.

We have already seen that if Di represents the actual diameter of the aperture, that $\frac{F}{Di} = Ra$. If this is true, then it must be obvious that $\frac{m}{Di} = Ra'$ or the true Ra at any extension. To find the value Di we have $\frac{F}{Ra} = Di$.

EXAMPLE: *(Involving a number of computations given in this appendix.)*

GIVEN: *A screen* 41 *inches wide (*1050 *millimeters) upon which we wish to project pictures of small beetles which in real life are* 1 *inch long. It is required that the screen image be* 1 *foot long. What computations as to conjugate foci, relative size and exposure are involved, when using a six inch lens at marked aperture of f* 8.

Relative size: We have seen that $R' = 100$ *with a screen* 1050 *millimeters wide.*

r in this case equals 12 *(*1 *inch to be enlarged to* 1 *foot).*

Then as R is equal to R′ divided by r, R equals 8.333.

Also as $M = F + FR$, *then* $M = 6 + 6 \times 8.333$ *or* $M =$ 55.998 *or practically* 56 *inches.*

The object is to be placed at 56 *inches from the lens. The lens extension or m equals* 6 + 6/8.333 *or* 6.722 *inches or about* 6¾ *inches. At this extension the true f value is determined in this manner.*

Marked Ra equals F/Di; conversely Di equals F/Ra or 6/8 *or* 0.75.

Then m or 6.722 *inches is divided by* 0.75 *or Di to give*

8.962 *or practically f9 the true relative aperture at which the exposure may be calculated. As* 8^2 *equals* 64, *and* 9^2 *equals* 81 *we have an exposure difference of roughly* 6 : 8 *or* 3 : 4, *which is quite enough to throw us off in calculation of exposure.*

DISTANCES FROM OBJECT TO SECURE LIFE SIZE PROJECTION.

It is often desirable to secure life size projection of any object upon the screen. This may be easily done by reference to the following table. In this table we have three factors; the focal length of the lens used, the size of the screen used and the distance of the subject from the camera. It is assumed in each case that the "screen" size given is the actual area covered by the frame of the film which measures approximately 0.3 x 0.4 inch.

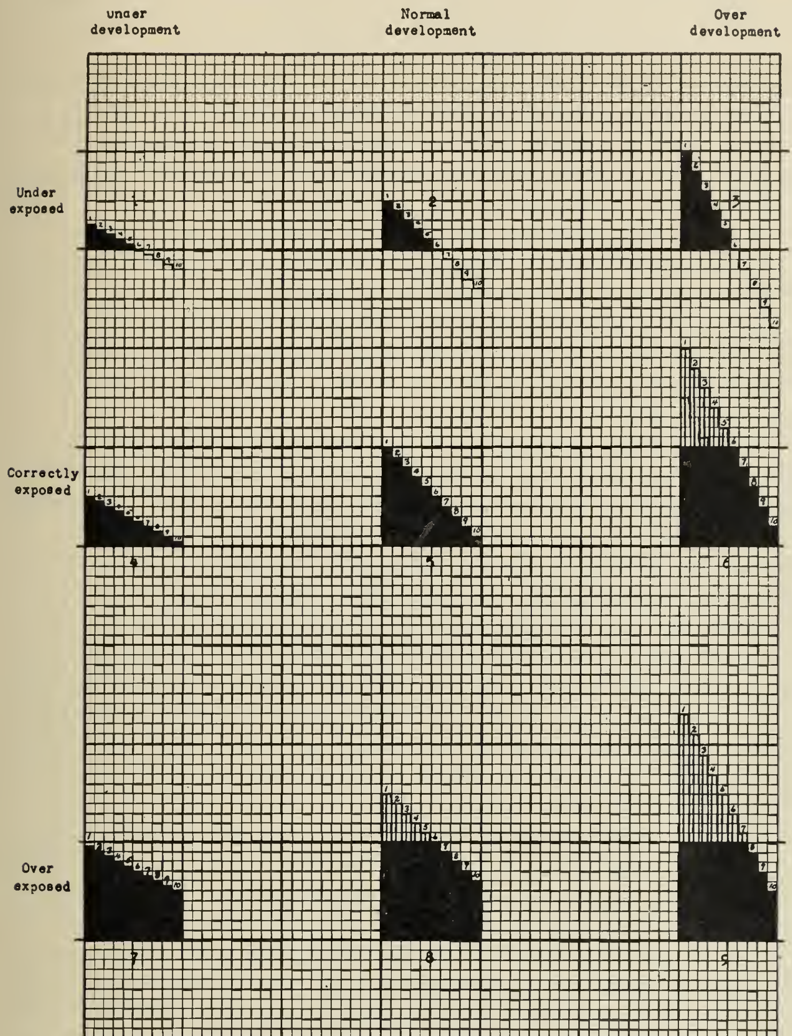
Focal Length of Lens	Screen Size 6x8	12x16	16x21	24x32	30x40	36x48	39x52	84x108
	Distance of object from camera lens.							
20 m/m.	1.5	3	4	6	7	9	9.75	21
25 m/m.	1.75	3.5	4.6	7	8.75	10.5	11.37	24.5
35 m/m.	2.5	5	7.6	10	12.5	15	16.25	35
50 m/m.	3.5	7	9.3	14	17.5	21	22.75	49
3 inch	5	10	13.3	20	25	30	32.5	70
3¾ inch	6.6	13.25	17.65	26.50	33.1	40	43.3	92.75
4 inch	7	14	18.6	28	34	42	45.5	98
6 inch	10.5	21	28	42	52.5	63	68.25	147

EXAMPLE: *Let us suppose that you use a* 30 x 40 *inch screen, one of the most popular sizes in use for amateur projection. You wish to make a close-up showing a member of the family in full life size. You are using the usual one inch or* 25 *millimeter lens. Find* 25 *m/m in the left hand column. Follow this line to the right, where under the screen size* 30 x 40, *you will find the distance* 8.75. *The subject, then, must be* 8¾ *feet in front of the camera if the film is to be projected later in full life size. Remember that a change in screen size also changes the size of the image projected from any given film.*

For convenience of those who are not familiar with the metric system, the accompanying table of equivalent focal lengths is given:

4/5 in.	1 in.	1⅜ in.	2 in.	3 in.	3¾ in.	4 in.	6 in.
20mm.	25mm.	35mm.	50mm.	75mm.	89mm.	100mm.	150mm.

RELATION OF EXPOSURE AND DEVELOPMENT.



The effect of exposure and development.

The one great prevailing fault among ciné amateurs of to-day is their neglect of exposure. The thought seems to be, "Oh well, let the laboratory take care of it!" The sooner the amateur realizes that this is impossible, the sooner amateur cinematography will approach professional in quality. The laboratory can smooth over the gross errors to a cer-

tain degree, but no laboratory can put quality in the negative which was not impressed upon the film during exposure.

To make this more plain, the accompanying chart is given. Here we have in exaggerated form the three degrees of exposure with the three corresponding degrees of development. This gives us nine combinations of which one *and one only* is correct. This is number five, correctly exposed and correctly developed.

In each exposure set we have a broken line at the top indicating one limit of the positive scale and a solid line at the bottom which indicates the opposite limit of the positive. Any negative gradation lying above the broken line will print upon the positive as pure white, while any gradation lying below the solid line will be reproduced as solid, untoned black.

For example, in figure one we have a very thin, flat negative. Steps from one to five are shown upon the negative as five slightly different deposits of silver. Step number one is very light in color and the others become still more light until at six we have no deposit. A print from such a negative will be dark, dull and flat. But if we try to compensate for the underexposure by over-development as in figure three, we have the heaviest deposit solid black, giving us a white upon the positive, but all steps from six to ten are below the scale limit and all of these will print as solid black. Here we have a full range of tone from black to white, but the result is harsh as fully half of the tones are represented as solid black.

If we overexpose as in figure seven, we get a differentiation in all gradation steps, but the difference between any two steps is slight, due to under-development. This gives a thin positive full of detail. If we develop this negative normally we get the first six steps giving us pure white with the lower scale printing lightly. If we increase printing exposure we can lift the entire scale upward. *At times* it is possible to get a good print from an overexposed correctly developed negative, but as a rule satisfactory films are possible only as a result of correct exposure and correct development.

THE METRIC SYSTEM

In photography and in cinematography we are constantly encountering measures of length, volume and weight given in metric units. For convenience, the following conversion

tables are given. It is hoped that they will often prove serviceable.

AVOIRDUPOIS TO METRIC

Grains	Grams	Grains	Grams	Grains	Grams	Grains	Grams
1	0.065	6	0.389	10	0.648	60	3.888
2	0.13	7	0.454	20	1.296	70	4.536
3	0.194	8	0.518	30	1.944	80	5.184
4	0.259	9	0.583	40	2.592	90	5.832
5	0.324	10	0.648	50	3.240	100	6.480

Ounces	Grams	Ounces	Grams	Ounces	Grams
¼	7.09	0.1	2.83	1	28.35
½	14.17	0.2	5.67	2	56.70
¾	21.26	0.3	8.5	3	85.05
		0.4	11.34	4	113.40
		0.5	14.17	5	141.75
		0.6	17.01	6	170.10
		0.7	19.84	7	198.45
		0.8	22.68	8	226.80
		0.9	25.51	9	255.15
		1.0	28.35	10	283.50

ENGLISH—METRIC CONVERSION TABLES

INCHES TO MILLIMETERS

Inches	Mm.	Inches	Mm.	Inches	Mm.
1/32	0.8	5/16	7.9	¾	19.1
1/16	1.6	11/32	8.7	13/16	20.6
3/32	2.4	⅜	9.5	⅞	22.2
⅛	3.2	7/16	11.1	15/16	23.8
3/16	4.8	½	12.7	1	25.4
7/32	5.6	9/16	14.3		
¼	6.4	⅝	15.9		
9/32	7.1	11/16	17.5		

MILLIMETERS TO INCHES

Mm.	Inches	Mm.	Inches	Mm.	Inches
1	0.04	10	0.39	19	0.75
2	0.08	11	0.43	20	0.79
3	0.12	12	0.47	21	0.83
4	0.16	13	0.51	22	0.87
5	0.20	14	0.55	23	0.90
6	0.24	15	0.59	24	0.94
7	0.28	16	0.63	25	0.98
8	0.31	17	0.67		
9	0.35	18	0.71		

METRIC WEIGHT TO AVOIRDUPOIS

NOTE: All photographic formulae are compounded by avoirdupois weight unless otherwise specified.

Grams	Grains	Grams	Grains	Grams	Ounces	Grains
0.1	1.5	1	15.4	10	.	153.9
0.2	3.1	2	30.9	20	.	308.8
0.3	4.6	3	46.3	30	1	25
0.4	6.2	4	61.7	40	1	180
0.5	7.7	5	77.2	50	1	334
0.6	9.1	6	92.6	60	2	51
0.7	10.8	7	108	70	2	203
0.8	12.4	8	123.1	80	2	360
0.9	13.9	9	138.5	90	3	76

Grams	Ounces	Grains	Grams	Ounces	Grains
100	3	230	600	21	70
200	7	24	700	24	300
300	10	250	800	28	95
400	14	50	900	31	325
500	17	280	1000	35	120

METRIC TO ENGLISH RAPID CONVERSION TABLE—LENGTH
DECIMAL FRACTIONS REPRESENT PARTS OF ENGLISH INCHES

No. of Units	Millimeters	Centimeters	Decimeters	Meters
1	.03937	0.3937	3.937	39.37
2	.07874	0.7874	7.874	78.74
3	.11811	1.1811	11.811	118.11
4	.15748	1.5748	15.748	157.48
5	.19685	1.9685	19.685	196.85
6	.23622	2.3622	23.622	236.22
7	.27559	2.7559	27.559	275.59
8	.31496	3.1496	31.496	314.96
9	.35433	3.5433	35.433	354.33
10	.3937	3.937	39.37	393.7

EXAMPLE—*What is the focal length in inches of a lens marked* 46 *mm.?* 46 *millimeters equals four centimeters plus six millimeters or* 1.5748 *inches plus* .23622 *inch or* 1.81102 *inches.*

What is the English equivalent for 12.637 *meters? This is resolved into* 10 *meters plus* 2 *meters plus* 6 *decimeters plus* 3 *centimeters plus* 7 *millimeters. This is changed by reference to the table above to this sum in simple addition:*

393.7
78.74
23.622
1.1811
.27559

497.51869 *inches or approximately* 41.45989 *feet, disregarding the sixth decimal point.*

THERMOMETRIC CONVERSION TABLES

Both Fahrenheit and Centigrade systems of measuring temperature are common in this country, while the Reaumur system is not as common. We may regard the Reaumur system as obsolete and confine our attention to the Fahrenheit and Centigrade systems only. Fahrenheit system takes 32° as freezing and 212° as boiling, while the Centigrade starts with zero as freezing and 100° as boiling. Fahrenheit is our common system, while Centigrade is the scientific system and a part of the metric system of measurement.

To Change Fahrenheit Reading to Centigrade:
Subtract 32, multiply by 5 and divide by 9.
Example—65°F — 32 × 5 ÷ 9 = 18.33°C.

To Change Centigrade Reading to Fahrenheit:
Multiply by 9, divide by 5 and add 32.
Example—20°C × 9 ÷ 5 = 36.36 + 32 = 68°F.

Fahrenheit-Centigrade Comparison Scale in 5° Steps

F	C	F	C	F	C
0°	17.78°	70°	21.11°	145°	62.78°
5°	15°	75°	23.89°	150°	65.55°
10°	12.22°	80°	26.67°	155°	68.33°
15°	9.44°	85°	29.44°	160°	71.11°
20°	6.67°	90°	32.22°	165°	73.89°
25°	3.89°	95°	35°	170°	76.67°
30°	1.11°	100°	37.78°	175°	79.44°
32°	0°	105°	40.55°	180°	82.22°
35°	1.67°	110°	43.33°	185°	85°
40°	4.44°	115°	46.11°	190°	87.78°
45°	7.22°	120°	48.89°	195°	90.55°
50°	10°	125°	51.67°	200°	93.33°
55°	12.78°	130°	54.44°	205°	96.11°
60°	15.55°	135°	57.22°	210°	98.89°
65°	18.33°	140°	60°	212°	100°

The up-to-date and scientific cinematographer will adopt the Centigrade system of temperature measurement in his laboratory along with the other metric measurements.

SUBSTANDARD SIZES

In the substandard field we have several sizes, some of which are known as substandard and others as off-sizes. Some of the better known are:

9½ mm. gauge—Pathex and Ciné-Nizo

16 mm. gauge—Eastman Ciné-Kodak, Bell & Howell Filmo, Oxford, Victor, Salex, Ciné-Nizo, Ciné-Geyer, and others

17½ mm. gauge—Ernemann, Movette, Pathe-Rural, etc.

24 mm. gauge—Pathescope, Victor Safety

The last mentioned size has become practically obsolete as it lacks advantages of both 35 mm. (standard) and of substandard films.

As the celluloid ribbon is nothing more than a vehicle for the emulsion, its size has little to do with the picture size. For purposes of full comparison, let us compare the widths of the ribbon (the gauge), the size of the actual frame, the area of the frame, and finally the relation of this frame area to the area of the standard film.

Film Gauge	Frame Size	Frame Area	Relative Area
35 mm.	18 x 24 mm.	437 sq. mm.	1.000
9½ mm.	7½ x 8½ mm.	63.75 sq. mm.	0.150
16 mm.	7½ x 10½ mm.	78.25 sq. mm.	0.179
17½ mm. (a)	8.2 x 11 mm.	90.20 sq. mm.	0.206
17½ mm. (b)	9½ x 13½ mm.	128.25 sq. mm.	0.293
17½ mm. (c)	11½ x 15 mm.	172.50 sq. mm.	0.395
35 mm.	18 x 24 mm.	437 sq. mm.	1.000

Of the 17½ mm. gauges, the letters a, b, and c refer to:

(a)—Half normal film, or split standard film with unilateral perforations;

(b)—Pathe-Rural film;

(c)—Ernemann 17.5.

FORMULAE USED IN ABNORMAL EXPOSURE SPEEDS

In processes involving abnormal exposure speed, such as time, condensation, animation and such work, the camera speed, if continuous or the inter-exposure interval if the exposure is intermittent, must be carefully calculated.

The speed or interval should be of such duration that the image upon the negative will move about 0.1 millimeter.

In this case we have substandard film with a frame 10.5 millimeters wide. With a motion of 0.1 millimeter per frame, we will have to use 10.5 x 10 or 105 frames of film to carry the object entirely across the frame. This means that 2.6 feet of film will be used, or that the object will move entirely across the screen in 6.5 seconds. As this motion is seldom in a straight line, it is a fair average, but if the subject is to be rendered with even better detail, the single frame advance can be held to 0.05 millimeter which will give us a cross screen movement in thirteen seconds.

For work of this nature a camera with an attachable hand crank is of great advantage, and one which may be operated to give one exposure at a time is quite necessary.

EXAMPLES:

a. Slow Moving Objects Such as Clouds

The subject is allowed to cross the field of vision while being observed in the finder. If the cross screen speed of six seconds is desired and we find that the travel across the finder requires one minute, we know that we must expose 96 frames of film in one minute or 96 frames in 60 seconds. This is 1½ frames per second. This may be approximated by using the trick crank and turning slightly slower than normal speed.

b. Very Slow Motion, as Plant Growth

Usually used with small plants showing first stages. We know the approximate time which will be required. Let us say that this is six weeks. In order to observe the growth, we will want to give this growth at least two minutes screen time. 16 x 60 x 2 is 1920, the number of frames to be used. We have six weeks equal to forty-two days, 1,028 hours, 61,680 minutes, or 3,700,800 seconds. At normal speed this would require 59,212,800 frames of film. We see that we have 1920 exposures to make in 1028 hours. In round numbers this will be one exposure every half hour. This will give us 2048 frames or 128 frames more than we had counted upon. This will cause our film to run eight seconds overtime. So we use a thirty minute interval in our exposure.

c. To Photograph a Cartoon in Process of Animation

A convenient size for the separate sheets of drawings is 7½ x 10½ inches. In this case we have a ratio between the sheet size and frame size which is equal to the ratio existing between inches and millimeters.

We proceed as in example (a) to determine the rapidity of cross screen movement and we will suppose that the six second rate is determined upon. We know then that the image must move about 0.1 millimeter per frame, and as we have an inch to millimeter ratio, the cartoon will advance 0.1 inch per exposure. The same calculations may be made in regard to dolls, models or other animation.

In arm movements, this speed may be greatly accelerated, the movement being increased to as much as one inch per exposure. In turning the head, the start and finish is all that is necessary. Detailed motion is seldom necessary except in case small objects are being shown.

In cases involving wheels, gears and so forth, turning, great care must be used. As such a wheel will be divided into sections by spokes, teeth or other projections, these parts must serve as units for the motion. The forward motion must never exceed 1/3 such unit space, for if the advance of motion is less than one and more than one-half, the wheel will rotate in reverse direction. If the advance is one and one-third the effect will be identical with that obtained by advancing the wheel one-third. This is supposing that all divisions of the wheel are identical.

DEVELOPING AND OTHER CHEMICAL SOLUTIONS USED IN MOTION PICTURE WORK.

The amateur who wishes to experiment in home development of films will find practically every formula he needs among the following formulae which have become standardized for motion picture work. While any good developing bath may be used these are the ones recommended.

Developers

Number Sixteen

Water	1 gallon
Metol	18 grains
Sodium sulphite	5-1/3 ounces
Hydroquinone	352 grains
Sodium carbonate	2½ ounces
Potassium bromide	50 grains
Citric acid	40 grains
Potassium metabisulphite	90 grains

M-Q

Water	1 gallon
Sodium sulphite	3 ounces

Hydroquinone	340 grains
Sodium carbonate	2 ounces
Metol	21 grains
Citric acid	26 grains
Potassium Metabisulphite	85 grains

Contrast or Title Developer

Water	1 gallon
Sodium sulphite	2½ ounces
Hydroquinone	385 grains
Sodium carbonate	2½ ounces
Potassium bromide	50 grains

Universal M. P. Negative Developer

Water	1 gallon
Metol	34 grains
Sodium sulphite	3 ounces
Hydroquinone	130 grains
Sodium carbonate	1 ounce
Potassium bromide	20 grains
Citric acid	40 grains

Universal M. P. Positive Developer

Water	1 gallon
Metol	30 grains
Sodium sulphite	2¼ ounces
Hydroquinone	60 grains
Sodium carbonate	1¾ ounces
Potassium bromide	22 grains
Sodium hydroxide	100 grains

Developer for Reversal

Water	1 gallon
Sodium sulphite	11 ounces
Hydroquinone	1 ounce
Sodium carbonate	7 ounces
Potassium bromide	1 ounce

High contrast developer giving reversed prints which are far superior to the usual "flat" reversed positive.

Reversal Bath

Water	1 gallon
Potassium bichromate	1½ ounces
Nitric acid	3 ounces

Reversal Developer (Second)

Use developer given above or any metol-hydroquinone formulae the choice being governed by the degree of contrast wanted.

Fixing Bath

Water	1 gallon
Hypo	2 pounds

Dissolve and add the following hardener

Water	4 ounces
Sodium sulphite	175 grains
Powdered alum	350 grains
28% acetic acid	2½ ounces

Alternative Fixing Bath

Water	1 gallon
Hypo	2 pounds

Hardener:

Water	10 ounces
Sodium sulphite	1 ounce
28% acetic acid	6 ounces
Powdered alum	1 ounce

To Reduce Films Which Are Too Dense

A Bath

Water	1 gallon
Hypo	8 ounces

B Bath

Water	16 ounces
Potassium ferricyanide	1 ounce

Mix immediately before use.

Place in bath until density is sufficiently reduced, always rinsing film before examining to prevent streaks. Wash thoroughly and dry. This reducer increases contrast.

To Intensify Thin and Weak Films

A Bath

Water	1 gallon
Mercury bichloride	2 ounces
Potassium bromide	2 ounces

Allow to remain in this bath until thoroughly whitened, rinse carefully and place in

B Bath (mix fresh)

Water	1 gallon
Sulphite of sodium	16 ounces

Allow to remain until thoroughly cleared.

Note—Film must be thoroughly washed and free of hypo before intensification.

Toning Films

The thoroughly washed film is placed in the

Bleach

Potassium bromide	400 grains
Potassium ferricyanide	3 ounces
Water	1 gallon

Film is allowed to remain in the bleach until all blacks have turned to buff. It is rinsed for not more than one minute and then placed in the

Sulphide Bath

Sodium sulphide (Not sulphite)	20 ounces
Water	1 gallon

When thoroughly toned, which should be within thirty seconds, the film is rinsed and dried.

Pathe Reversal Process

The following is one of the most satisfactory methods of securing positives by reversal yet produced.

The films are divided roughly into four classes, according to the time required for the image to appear in the first developing bath. This factor determines the total length of development.

Class	First Appearance	Total Development
A	Within first 20 seconds	About 6 minutes
B	20 to 40 seconds	About 12 minutes
C	40 to 60 seconds	About 15 minutes
D	Up to 1½ minutes	Maximum 25 min.

In the case of severely underexposed films the absolute maximum period of development is 28 minutes.

First Developer

Para-phenylene-Diamine compound (Pathe)	1 oz. 22 gr.
Sodium hydroxide	150 gr.
Water	35 ounces

When film is developed according to class, it is rinsed and placed in the reversal bath.

Reversing Bath

Potassium permanganate	30 grains
Sodium bisulphate	380 grains
Water	35 ounces

(170 minims sulphuric acid may be substituted for the sodium bisulphite.)

Treat in this bath for 7 to 10 minutes until dense black deposit is removed. Wash thoroughly and then continue process in full daylight. It is placed in the

Clearing Bath

Sodium bisulphite	75 grains
Sodium sulphate	75 grains
Water	35 ounces

Allow to remain until whites are transparent, then add to above bath

Sodium Hyposulphite	150 grains

This forms the second developer. Allow to remain until image is fully darkened, wash thoroughly and dry. The above mentioned chemicals may be obtained from Pathe Freres, Vincennes, France.

GLOSSARY

In each sport, in each pastime, in every art and in every craft we have a certain vocabulary which is known as the "technical vocabulary" of that particular field of activity. In cinematography we have an extensive professional technical language, and from this we take many words for amateur use. In addition there are a certain number of words which are limited to use in connection with amateur cinematography. These words are given in this list, not as a lesson to be learned, but as a reference to be used in determining definitions of strange words.

Action—The events of a dramatic motion picture; the development of a story.

Actograph—An amateur motion picture camera, one of the first made.

Agfa—Name of manufacturer of 16 m/m motion picture film.

Amateur—One who makes motion pictures for pleasure. Usually quite expert in the work. The word has no relation to the size of film or type of camera used.

Angle, Camera—The angle of view taken by the motion picture camera through the two outer edges of the picture give the camera angle. Occasionally it may mean the vertical angle of the camera.

Angle Shot—An insert scene continuing the same action but shot from another angle.

Animation—Photographing inanimate objects in such a manner that, upon the screen they appear to have the power of voluntary motion.

Aperture—In speaking of lenses, aperture means the iris diaphragm opening. In speaking of motion cameras or projectors it means the oblong hole which frames the picture being taken (or projected). Do not allow these two different meanings to confuse you.

Aperture Plate—The metal plate around the picture opening in the camera or projector.

Arc—A form of electric light caused by bringing into incandescence the tips of two carbon rods.

Art Titles—Motion picture titles with designs showing in the lettered background of film captions.

Artificial Light—Any source of light not originated direct from sunlight.

Automatic—Operating by virtue of self contained power. —Arc, an arc light which readjusts itself when necessary.—Camera, a camera which is driven by a spring or other motor.—Projector, this may mean either a motor driven or a self threading projector.

Axis, Lens—A line passing through the center of a lens perpendicular to the surface.

B. & L.—Bausch & Lomb—Lens manufacturers.

B. & H.—Bell & Howell.

Back Focus—Distance from rear surface of a motion picture lens to the focal plane.

Back Light—The so-called Rembrandt lighting where strong light is thrown on the actors from the back—giving a halo of light about the figure.

Balloon—The outline around a spoken cartoon title.

Barrel Distortion—A lens defect which causes the image of parallel lines to bulge outward.

Base—The celluloid component of motion picture film.

Bath—Any chemical solution used in treating photo materials.

Bead Screen—A screen made by covering a suitable surface with millions of almost microscopic glass beads.

Bell & Howell—A firm manufacturing motion picture cameras and accessories.

Binocular—The conventional design of two overlapping circles used to indicate the view seen through field or opera glasses.

Biograph—An old term for motion picture—also one of the first motion picture companies.

Black Maria—Thomas Edison's first studio.

Black Matte—Opaque mask as distinguished from a semi-transparent one.

Brief Synopsis—The story of a scenario told in a few hundred words.

Buckling—When film fails to run through camera properly it is said to "Buckle." Usually due to intense heat.

Business—A definite bit of action. "Business of making

love" indicates that character referred to is to make love to someone else designated in the scenario.

Camera—An instrument for recording scenes upon a ribbon of celluloid for the production of motion pictures.

Cameralite—A portable arc light which resembles a roll film camera when closed.

Camera Mount—Any kind of camera support other than a tripod; as camera mount on table, camera mount for automobile.

Caption—A motion picture subtitle in a film or the written wording intended for a subtitle.

Carbons—Arc light carbons.

Cartoon—Often applied indiscriminately to any kind of animated drawing or diagram.

"Cell"—One of the sheets of celluloid used in making animated cartoons and similar work.

Celluloid—1, film base—2, in cartoon work any drawing on a transparent base is a celluloid or a "cell."

Changing Bag—A light tight cloth bag with armlets in which plates or films may be changed in the open.

Characters—The fictitious persons whose actions make the story of a scenario or play.

Character Title Writer—A device for making titles for motion picture film. It is also used in making closeups of small objects, cartoon work and similar work.

Chart 1—In elaborate trick work a graph or chart is sometimes used as a guide in matching exposures.

2—A card with geometrical areas of black and white for easy focussing and for testing lenses.

3—A chart may be any table of figures for quick and ready reference for focussing, timing exposure, mixing solutions, printing negatives, etc.

Chemical Rays—Actinic light.

Chiaro Oscuro—Aerial perspective.

Ciné—Pertaining to motion pictures.

Ciné-Kodak—a 16 millimeter motion picture camera made by Eastman Kodak Company.

Cinematographer—The person who operates a ciné camera.

Cinemicrography—Cinematography of microscopic objects by special methods.

Cinching Up—Tightening a roll of film by holding the center and pulling on the outer end. A good way to scratch film and make "rain" marks.

Cinophot—A pocket photometer for determining the proper exposure for motion picture film.

Circle of Confusion—The round image of a point of light not in focus.

Circle In—Same as iris in.

Circle Out—Same as iris out.

Claws—The metal fingers or pins which engage in the film perforations to move it intermittently downward in the camera, or projector.

Climax—The supreme moment in a photoplay, the culminating point to which all the action trends.

Close-Up—Anything taken by the movie camera at a distance of four or five feet or less—used alone it generally means head and shoulders of actor but may be used as: Close-up of face, close-up of locket, close-up of note book. Close-ups of small articles, letters and telegrams are also called inserts.

Color—Anything which adds to the supposed character of a scene is "color" or "atmosphere."

Color Screen—A ray filter used before the camera lens to get different tonal rendering of color values.

Color Filter—Same as color screen.

Composition—Arrangement of objects in a scene according to art principles.

Compo Board—Composition board—used extensively by amateurs for building scenery and for many other purposes.

Concave—Hollowed inwards.

Condenser—A special lens used for producing a greater illumination in projecting than would be otherwise possible.

Continuity—The story or scenario as ready for production. Continuity describes the business and action of the consecutive scenes.

Continuous Action—An uninterrupted sequence of action between characters.

Convex—Bulged out.

Contrast 1—In prints is where the shadows are very black and dense and the whites very transparent and chalky. *2*—Contrast is also used to indicate opposing emotions and conditions in dramatic action—poverty emphasizes riches, hatred contrasts love.

Crank—Handle of manually operated cameras.

Crepe Hair—Artificial hair used for building up beards, mustaches and shaggy eyebrows.

Crisis—A critical moment in a photoplay but of less importance than the climax.

Cut—Stop the action, end of the scene.

Cut In—Any close-up or insert which is interpolated into a longer shot.

Cut Back—Where two trains of action take place simultaneously, the secondary action is shown in cutbacks. For example, the girl is struggling with the villain and far away the hero rides to the rescue. We see the girl struggling, then the cutback to the hero riding furiously, then to the girl again and so on.

Cutting—Editing film.

Cutting the Negative—Matching the master negative up with the edited first print.

Da-Lite—An arc light made for amateur and semi-professional work.

Dallmeyer—A make of high grade ciné lenses.

Dark Room—Room where film is developed. It is dark except for dim red lights.

Daylight Screen—A screen used for the projection of motion pictures without using a darkened room. This may be of the translucent or Translux type or a shaded silver screen such as the Kodak OO.

Decorative Titles—Same as art titles.

Definition—The sharpness or clearness with which objects are defined by a lens.

Density—The amount of opaque silver deposit in a photographic image.

Depth 1—Pseudo Stereoscopic effect.

2—The range within which objects are in focus in a photographic print.

Descriptive Title—A title used to describe something not shown in the action or to cover a time lapse.

Develop—Bringing up the latent photographic image.

Developer—The solution used to develop film.

DeVry—Manufacturers of motion picture cameras and projectors in both 16 mm., and 35 mm. sizes.

Diaphragm—The iris-like mechanism in a photographic lens.

Director—The person who directs or stages a motion picture production.

Discovered—A term used to show that a character is present in a scene at the time it starts.

Dissolve—The gradual change of one scene into another, made by over-lapping the fade-in of one scene on the fade-out of another.

Dissolve In—Where the picture emerges gradually from the darkened screen. "Fade in" is a better term for this. Made by slowly opening the lens diaphragm.

Dissolve Out—Picture fades away to dark screen. "Fade out" is a better expression. The reverse of "dissolve in."

Doll Work—Animation using dolls and toys as actors.

Double Exposure—A composite picture made by exposing the same film twice.

Double Printing—A composite picture made by printing from more than one negative on the same strip of positive film.

Dream Picture—A picture of improbable nature finally explained as being a dream.

Drem—Trade name for a number of photographic accessories.

Dremette—An instrument for making paper enlargements from 16 millimeter frames.

"Dupe"—See duplicate.

Duplicate—In reversal there is no negative so when more than one copy of a film is wanted it must be made from the existing positive, or "duplicated."

DuPont—Name of manufacturer of 16 m/m motion picture film.

Dyed Film—Positive film tinted with colored dye.

"Eastman"—A trade-mark of the Eastman Kodak Company applied to photographic goods.

Edinol—A developing chemical.

Editing Film—Arranging the scenes and titles of a motion picture into proper sequence for exhibition.

Editing Rack—Rack for holding the cut scenes in editing film. A very necessary item.

Educational Films—A general term for almost any film not of dramatic or comedy nature and does not necessarily mean a film for instructional purposes. Scenic, travel films, industrial pictures, novelty and review pictures are all often classed as "Educational."

Effective Aperture—The concentrating of light rays by the front lens element makes the measured diameter of a diaphragm opening less than its mathematically calculated equivalent. In other words, a diaphragm opening the effect of which is the same as the calculated opening is called the effective aperture.

Elon—A developing agent.

Emulsion—The dull coating of film, which is sensitive to light action:

English Weights—English and American weights and measures are not always equivalent. Consult tables for equivalents.

Enter—A term used to designate the entrance of a character on the scene.

Episode—A section of a serial film usually in two reels.

Ernemann—Name of a German manufacturer of motion picture cameras and apparatus.

Ether 1—A term for the intangible medium which pervades the universe and which transmits light, radiant heat, X-rays, radio waves and other vibrations.

2—Ether is the common name of sulphuric ether, a volatile liquid used as a solvent and anesthetic.

Exit—The departure of an actor from the scene.

Exposure—Making the impression on the emulsion by opening the shutter and allowing the lens image to act on the sensitive surface.

Exterior—A scene taken outside of a building. Usually anything taken outside the studio, although exterior sets are not uncommonly built in the studio. On exteriors means working outside the studio.

Extras—A term used to indicate the supernumeraries or "extra" people who comprise the mobs, crowds, guests or other persons who are incidental to the plot of a picture.

Eye Piece—The lens element to which the eye is applied in any telescope, microscope, binocular, focussing device or other optical instrument.

Factor—A number used to indicate the relation of one thing to another as regards its value for speed, time, duration or any other purpose.

Fade—Fading of the picture to blackness by gradually decreasing the exposure to nothing. Also called fade out.

Fade In—Causing the picture to emerge from darkness by increasing the exposure from nothing to normal.

Fade Out—See Fade.

Fake—Any artificial means for accentuating a desired effect in pictures is called faking.

Farce—Exaggerated comedy.

Fancy Masks—Masks for framing the picture in the aperture plate for decorative effect, such as heart shape, card pip shape, arch way, silhouette, etc.

Farmer's Reducer—A reducing solution the principal ingredient of which is potassium ferricyanide.

Field—The field of a lens in the angular measurement of the view which it takes. A one inch cinematograph lens has a field of about 21°.

Filming—Producing a picture.

Filmo—Bell & Howell automatic substandard camera. Also applied to accessories for this camera.

Film Stock—Unexposed film, either negative or positive.

Film Slide—Single exposures made upon standard film and projected one at a time. Replacing the old glass slide lantern.

Filter—A colored glass does not transmit certain colors of light, i. e., it filters light. Used to accentuate or suppress the tonal value of colors.

Flare—A pyrotechnic product used for exterior illumination when electricity is not available.

Flash—A very short scene.

Flashback—See Cutback.

Focal Length—The measurement from a lens to the image when the object is at a great distance.

Focus—The point or plane in which a lens produces a sharp image. To focus is to adjust the lens so that the image of the principal objects are sharp and in the lens field.

Focus, Back—Back focus is the distance from the outer surface of the rear lens element to the focal plane.

Fodis—A Leitz range finder made for use in amateur cinematography. Very small and extremely accurate.

Fog—A fog or veil on a negative or positive; generally caused by light striking the sensitive surface from some other source than the lens. Fog may also be due to deteriorated materials or the action of impure or old chemicals.

Formaldehyde—A chemical used for hardening the emulsion when softened by heat.

Foreground—That part of a picture which represents the objects nearest the camera.

Formula 1—A recipe for compounding a solution.
2—A mathematical equation in which letters represent values to be assigned according to the problem which is to be solved.

F. System—The method of calibrating lens diaphragms in terms of the focal length.

Frilling—Separation of the emulsion from its support at the edges.

Fringe—The colored outline of an image produced by an uncorrected lens.

Geneva Movement—An intermittent movement produced by a cam and star wheel. The movement used in most projection machines.

Ghost 1—A ghostly apparition in pictures produced by double exposure.
2—Blurring produced in pictures where the shutter does not operate in correct synchronism with the moving film.

Goerz—Name of a maker of Ciné lenses, camera attachments and motion picture film.

Goerz Devices—A number of amateur motion picture camera accessories made by C. P. Goerz, such as the sliding base, reflecting focussing device, outside iris, focussing microscope, mask box, color filters, lens extension, lenses, etc.

Goerz-Tenax Meter—A distance meter made by Zeiss-Ikon. Small and compact but unusually accurate.

Gradation—The scale of tonal values in a picture.

Graduate—A measuring vessel for fluids.

Graduated Filter—A color filter dark yellow at one end and clear glass at the other, used for correcting skies while leaving foreground uncorrected.

Granularity—Coarseness in the silver grains in a photographic image.

Grease Paint—The sticks of color used by actors to prepare their faces for screen photography.

Halation—The ghostly halo sometimes seen about the image of a bright object in a photo.

Half Tones—The intermediate shades between white and black.

Halldorson—Manufacturer of amateur ciné arc lights.

Halo—Same as Halation.

Hand Dissolve—A device, operated by hand, to fade in or out.

Hardener—A solution used to harden photographic emulsion.

High Lights—The lightest parts of a picture.

Hood, Lens—A tube or box designed to protect the lens from light not needed to form the image, such as strong side lights or direct sunlight.

Humidor—A can or box fitted with an absorbent pad which is moistened, keeping stored films in good condition.

Hurter & Driffield—A system of ascertaining the relative speeds of photographic emulsions; named after the inventors.

Hydroquinone—A developing chemical.

Hypo—The photographic nickname for hyposulphite of soda (sodium thiosulphate) or its solution. It dissolves the sensitive silver salt from the image after development and "fixes" it from further light changes.

Image—The picture produced by a lens.

Image, Real—An image formed by a lens or curved mirror that can be shown on a screen.

In and Out Movement—That part of the intermittent movement which moves the claws in and out of the film perforations.

Index of Refraction—A number which indicates the relative power of different kinds of glass to bend light rays.

Industrial Films—Films showing manufacturing processes and production of materials.

Infra Red Rays—The invisible radiant heat of the lower end of the spectrum.

Instructional Films—Films intended for teaching purposes; instructional is used in a much narrower sense than educational.

Intensify—To increase the density and contrast of a photographic image with a chemical solution.

Interior—Any motion picture scene representing an enclosed space, a studio scene.

Inversion—All photographic lenses invert the image of the object in the camera.

Iris—A mechanism in which the round opening may be closed uniformly with an action similar to that of the iris of the eye.

Kodak—A trade-mark of the Eastman Kodak Company applied to a line of its cameras, films and other photographic goods.

Kodascope—The Eastman 16 millimeter motion picture projectors.

Laboratory—A place where films are developed and finished.

Lacquer—Celluloid solutions, either colored or transparent, with which nearly all camera parts are coated for protection and finish.

Lantern Slide—A photograph on glass for projection on a screen.

Latent Image—The photographic image before development.

Latitude—The range of exposure within which a photographic emulsion will produce a satisfactory picture.

Lead—The leading character in a photoplay, either male or female.

Leader—The blank film at the beginning of a reel of film.

Leica—A very small, high quality camera making single exposures 1 x 1½ inches on standard motion picture film. Used in making "film slides."

Lens—There are lenses of hundreds of varieties for thousands of purposes but the word is used most commonly in photography in referring to the lens which forms the photographic image.

Lens Barrel—The metal tube in which a lens is mounted.

Lens Board—That part of the camera on which the lens is mounted.

Lens Extension—An extension for the lens barrel enabling objects very close to the camera to be photographed. This gives a very large screen image.

Lens Hood—See Hood.

Lens Mount—In many motion picture cameras the lens mount is also the focussing device.

Leoty—A type of amateur arc light.

Library Film—Films made for sale, ready for the projector, as distinguished from the films made by an amateur with his own camera.

Lighting—Arranging artificial lights or controlling natural light to obtain any particular effect in a picture.

Lighting, Line—See Back Light.

Little Sunny—A compact amateur arc light of high intensity. A Westphalen product.

Loading—Putting film into the camera.

Locale—The locality or environment in which a sequence takes place.

Location—Any place away from the studio used as a scene background.

Long Shot—A scene photographed with the camera set at a distance from the action; a full view.

Loop—The slack portion of film above and below the intermittent claws which allows them to operate without tearing the film.

Lumiere Carpentier Movement—The same as the Pathe or Harmonic Cam intermittent.

Machine Development—Development of motion picture film by automatic machinery.

Magnesium Torch—A flare giving an intense white light used for exterior at night and in caves and interiors where electricity is not available.

Main Title—The name of the photoplay as a whole.

Make-Up—Theatrical grease paint and accessories used to beautify or alter the features of actors. Also means role or character as "His 'make-up' is an Indian."

Maltese Cross—The star which is part of a Geneva intermittent movement.

Manuscript—The typewritten story, scenario or continuity.

Mask—A matte used next the film or front of the lens to block out a portion of the picture.

Mask Box—A device for holding masks in front of the lens.

Meter—A measuring instrument. In motion picture photography there are several kinds: light meter, speed meter, footage meter, exposure meter, distance meter, etc.

Metol—A developing chemical.

Metric System—The French system of weights and measures; it is often used in compounding formulas.

Micrometer Mount—A focussing lens mount of unusual precision.

Microphot—A device for using a compound microscope in connection with the motion picture camera for making motion films of microscopic objects.

Microscope, Focussing, 1—An accessory, separate from the camera, supplied by Bell & Howell for focussing the lens of the motion picture camera by direct vision. Lens is removed from the camera. *2*—A Goerz device for focussing the camera lens by use of a matched lens which occupies the position of the camera lens in taking.

Miniatures—Miniature sets are often used, generally in conjunction with trick photography, in making scenes that would otherwise be prohibitive on account of expense.

Minima—An amateur arc light which may be carried in the pocket.

Mount—The part or mechanism which holds the lens barrel.

Movement—The intermittent mechanism of a motion picture camera.

M. Q.—Abbreviation for Metol Quinol, the active ingredients of the most commonly used developing solution for motion picture film.

Negative—The photographic image produced in the camera from which positive prints are made.

Objective—An image forming lens.

Optical—Pertaining to lenses.

Orthochromatic—Giving correct color value.

Pam or Pan—To revolve the camera to take a panoramic view.

Panchromatic—Sensitive to all colors.

Panorama Head—The revolving device on a motion picture tripod which permits the taking of panoramic views.

Paramidophenol—A developing agent.

Pathe—Name of a French firm which manufactures Pathex motion cameras and films.

Pathe Movement—The harmonic cam intermittent.

Pedagogical Pictures—Pictures for school and college use for instruction.

Perkins—A make of amateur arc light.

Persistence of Vision—That faculty of the sight which causes an impression of light to persist for a short interval after the light has ceased.

Perspective—That property of a picture which gives the illusion of distance.

Persulphate—A chemical which reduces density and contrast at the same time.

Photo Dramatist—An author who writes photoplays.

Photometer—An instrument for measuring light or exposure.

Photomicrography—Photography of microscopic objects.

Photoplay—A drama in motion picture form.

Pillow Distortion—A lens fault which causes the image of parallel lines to curve inward toward one another.

Plot—The basic foundation of a story.

Positive—A film used for projection.

Positive Stock—Unexposed sensitive film intended for printing from motion picture negatives. It is slower and more contrasty than negative film.

Principals—The principal characters of a photoplay.

Prism—A bar of glass of triangular section.

Prismatic Eye—A B. & H. device for taking films at right angles to the apparent line of vision.

Printer—A machine for printing positives from motion picture negatives.

Probus Paint—An acid and alkali resisting paint much used in photo laboratories for painting tanks and trays exposed to the action of developing solutions.

Projector—A machine for exhibiting motion pictures on a screen.

Props—Short for properties. In theatrical and motion picture work a property is any article used or shown in a set. Often used to mean an imitation or fake, as prop jewelry or prop vase because imitations often show as well as the more expensive genuine article on the screen.

Property Plot—An itemized list of the articles and objects needed to produce a photoplay.

Pyro—A developing agent.

Quartz Lens—A lens made of quartz. It transmits ultra violet light to which most glass is opaque and is therefore very fast, but the image is soft and unsuitable for obtaining sharp detail.

Rack—The frame on which film is wound for tank development.

Real Image—A lens image which may be shown on a screen.

Rectilinear Lens—A lens which makes images of parallel lines without distortion.

Reducer 1—A solution for reducing the density of a photographic image.

2—Principal element in a developing bath.

Reflecting Focussing Device—A Goerz device enabling the lens to be focussed and the composition arranged behind the taking lens, just as in professional cameras equipped with visual focussing devices.

Reflex Focusser—See above.

Reflector—A light reflecting surface used for illuminating the shadow side of subjects being photographed.

Refraction—The bending of light rays by a transparent substance.

Register—To indicate by simulation. An actor registers "hatred" or other emotions in a scene.

Relief—Comedy or light action to contrast or relieve heavy dramatic action.

Rembrandt—See Back Lighting.

Retake—A scene retaken on account of some defect at the first filming.

Retrospect—Reverting to previous action. Such action may or may not have been shown before. Where a character makes a confession or tells something the scene dissolves back to the retrospect.

Reversal 1—Changing an image from left to right as in a mirror.

2—Changing a negative to a positive or vice versa by chemical means.

Rewind—A device for rapidly winding film from one reel to another, used in projecting, editing and assembling films.

Rhodol—A developing agent.

Rod and Crank—An intermittent motion obtained with a crank and connecting rod.

Rouge—Red grease paint used in making up.

Scenario—Outline of a photoplay indicating all scenes, business action and titles, inserts and subtitles.

Scenario Editor—A person employed by a producing company to read all manuscripts submitted and select those suitable for production.

Scene—The action in a photoplay that is taken without stopping the camera.

Scene Record—A memorandum photographed upon three or four frames of film for the purpose of identifying the scene.

Scenic Film—Films of scenery and travel.

Screen—The surface on which a motion picture is projected.

Script—Short for manuscript.

Sept—A camera, fully automatic, for making "Film slides."

Sequence—A connected series of incidents in a photoplay.

Sets—The painted scenery of an interior location is a set.

Shadows—The darker portions of a picture.

Shoot—Command to start turning the ciné camera.

Shot—The film of a scene; as a scenic shot, an interior shot, etc.

Shutter—That part of a camera which opens and closes the lens when making an exposure.

Silhouette—A scene in which only the outline of the characters is seen, generally against the sky or a bright background.

Situation—An involved relation of affairs in a drama.

Slate—See Scene Record.

Smoke Pots—A firework like a Roman candle which produces dense clouds of smoke. Used in fire scenes.

Soft Focus—An image not sharply defined yet giving a pleasant, dreamy rendering of the subject.

Spectroscope—An instrument for analyzing light.

Spectrum—White light spread out into its component colors.

Speed—In photography speed has a number of special meanings. Lens speed is determined by the amount of light which it can utilize for image formation. Emulsion speed refers to its relative sensibility to light. Camera speed refers to the number of frames exposed per second. Shutter speed to the quickness with which it can open and close, and so on.

Spiral Reel—A developing rack which holds the film in a spiral.

Spirit Figures—See Ghosts.

Spirit Gum—An adhesive used for attaching false hair in making up.

Splicer—A machine for making film splices in a rapid and accurate manner.

Split Reel—A 1000-foot reel containing more than one subject.

Split Stage—In trick work where a fraction of the set is taken at one time and the remainder at another.

Spoken Title—Any phrase in a subtitle supposed to have been spoken by an actor. Spoken titles should never be shown with decorative background.

Spot—Short for spotlight, a lighting unit which projects a concentrated spot of light.

Sprocket—A toothed wheel in a camera or projector which propels the perforated film like a sprocket chain.

Star—The actor who is featured in a stage or motion picture production.

Static—Discharges of frictional electricity which sometimes make branch-like markings on motion picture films.

Step Printer—A machine which prints a motion picture step by step, a "frame" at a time.

Stereoscopic—A picture that gives the same illusion of looking into space as the two eyes perceive in actuality.

Still—An ordinary photograph—called still to distinguish it from a motion picture.

Stinemann—A system of developing motion picture film in portable laboratory apparatus. Also the name of the inventor of the system. Stinemann racks, tanks and printer.

Stock—Unexposed Film.

Stop—Lens diaphragms are called stops.

Stop Motion—Making a motion picture one frame at a time. Used on natural objects it gives the appearance of impossibly swift, jerky motion and is often used for comedy effects. It is also used in animated work where the figures which are to simulate motion are moved slightly between each exposure.

Studio—A place where motion pictures are made.

Sun Shade—A shade to keep the sunlight from falling on the lens of the camera.

Supers—See Extras.

Super Speed—Motion pictures taken at several times normal speed; also called slow motion because when shown at normal speed the subject seems to move at very slow speed.

System, F—A system of marking lens diaphragms in terms of the focal length.

Tanks—Large containers in which films are developed in quantity.

Tank System—Developing in a tank according to a table calculated for time and temperature.

Tape Line—Used by motion picture cameramen to measure the distance from lens to object so that the lens may be

set to the distance scale without having to focus for sharpness. Superseded by distance meter.

Telephoto Lens—A lens which gives a large image of a distant object, while having short back focus.

Test 1—A short piece of film developed to ascertain whether the exposure and focus are correct.

2—A short picture made of an actor to "test" his action and appearance on the screen.

Test Chart—See Chart.

Treading—Placing film in a camera or projector ready to operate.

Thin—A negative or positive in which the silver image is thin or transparent.

Timing—Determining the printing light value necessary to make a good positive.

Time Condensation—Reducing the action of several hours or days into a few moments upon the screen. Similar to animation in some ways.

Tinted Film—Film that has been printed upon a colored celluloid base.

Titles—The printed captions in motion picture film.

Title Board—A background which supports the title letters or cards during photography.

Title Border—A decorative border surrounding the words of a title.

Title Card—The card upon which the title is written or drawn.

Title Frame—A cut out decoration used with various title cards to give a border effect.

Title Writer 1—One who writes titles.

2—See Character Title Writer.

Trailer—A length of blank film at the end of the motion film.

Translux Screen—A translucent screen used for daylight projection of motion pictures.

Trick Work—Making films showing impossible actions or occurrences.

Triple Exposure—A film made by exposing the same film in the camera three times.

Tripod—The three legged camera support.

Ultra Speed—See Super Speed.

Ultra Violet—The invisible rays of the upper region of the spectrum. They act strongly on sensitive emulsions.

Underexposure—Not enough light has been allowed to pass the shutter to give the proper exposure.

Verito—A Wollensak lens giving a soft definition, very good for closeups.

Victor—A well known manufacturer of cameras, projectors and accessories.

Vignette—A picture the details of which blend away to nothing at the edges.

Vignetter—Outside iris.

Violet Rays—See Ultra Violet.

Vision—An effect showing the thought or dream of an actor by means of double exposure.

Weak Negative—See Thin Negative.

Westphalen—Manufacturer of lights, reflectors and similar equipment.

Wide Angle Lens—A lens of short focus which takes in a wide field of view.

Wohl Lamps—Hard lights or arc lights.

Wollensak—Well known manufacturer of lenses and optical accessories.

Wyko—A film slide projector.

Zeiss—A manufacturer of cameras, lenses and optical devices.

INDEX

(*Figures in italic refer to illustrations*)

A

Aberration
——chromatic 131
——curved field 131
——linear 131
——spherical 131
Abnormal camera speed 426
Accellerator 286
Accent lighting 109
Actinic light 40
Acting
——facial expression 385
——the hands 385
Action
——completed 389
——unfinished 393
——of light 129
——off screen 386
Aluminum Screen 241
Amateur
——Cinema League 3-350
——film development 285
——makeup 377
——Movie Maker 169
——production 304
Amidol 286
Analytic films 328
Anastigmat lens 132
Angle
——camera 389-399
——composition 308
——lens 135
——shutter 23
Animal subjects 335-339
Animated cartoons 195
——titles 175
Animation 195
Arc lights 96-*110*-112-114-*118*-*121*-*124*-127-358
Archery 326
Art titles 165
Artificial light 94
Atmosphere 303-385
Atmospheric perspective 379
Avoirdupois to metric 423

B

Backlighting 88-106
Baseball 326
Basketball 326
Bead screen 242
Bell & Howell
——camera 23-29-*30*-67-74-*172*-*195*-200-202
——color filter for projector 252-*294*
——exposure meter *43*
——focussing microscope 64-*66*
——iris *155*
——Panorama tripod for 68
——projector 260-*261*
——title writer *172*-186-*195*
Bird subjects 339
Bleaching bath 276
Blind, working from 338
Blue toning 297
Break Shots 215-313
Brilliancy
——of lenses 138
——of screen image 296
Bromine, 270

C

Camera
——accessories 36-320
——angle 52-*63*-*389*-399
——as a tool 303
——care of 78-318
——Ciné Kodak 23-*26*-*27*-*29*-67-74-*128*-*312*-*313*-*331*
——DeVry 23-33-*35*-67-74-200-202
——Filmo 23-29-*30*-67-74-*172*-*195*-200-202
——interior of 21
——Leica 402-*403*
——manipulation 190-383
——miniature still 403
——motion picture 22
——Pathex 23-*24*
——remote control 338

Camera (*Cont.*):
——reverse 192
——speed 71
——tilt *54*
——Victor *21*-23-31-*32*-*65*-67-74-*110*-*147*-*156*-*173*-200-202
Cameralite 358-*110*
Cartoons, animated 195
Cast, amateur 352
Cement, film 228
Chaney, Lon 309
Character makeup 378
Character Title Writer *172*-186-*195*
Chromatic aberration 131
Chronological order 214
Ciné Kodak 23-*26*-*27*-*29*-67-74-*128*-*312*-*313*-*331*
Cinema Clubs 3-349-355
Cinematography
——abroad 320
——art of 303
——from hip level 321
——from moving support 202
——with prisms 322
Cinemicrography 343
Cinophot, *45*-*48*-*65*-108
Circle of confusion 56-*57*
Closeup 59-108-218-398
Coincidence, illusion of 391
Color
——Colorator 252-*293*
——costume 376
——filters 90-149-*151*-251-283-408
——photographic 150
——projector 251
——use of 408
——values 151
Colorator 252-*293*
Complementary masks 206
Composition 64-308
Condensor
——adjusting 239
——cleaning 239
——projection 238
Conjugate foci 58-415
Continuity 356
Contrast developer 428
Controlled shots 314
Conversion tables 422
——rapid metric 424
——thermometric 425
Cooke lenses 158
Coordination of motion 330
Copies upon M. P. film 292
Copyright 188
Costume
——color of 376
——historical 375
Costume (*Cont.*):
——material 376
——period 375
Curvature of field 131
Curves 308
Cutbacks 356
Cutting
——film 213
——first 232
——rack *220*-230
——table 219
——titles 219-231

D

Daguerre 273-280
Daguerreotype 272
Dallmeyer lenses 158
Depth of Focus 60-140-415
Development 271-284-420
——equipment for 287
——formulae 428
——home 285
——process of 288
——racks 289
——reduction 286
——tanks 288
Developers
——contrast 429
——formulae 428
——M. Q. 428
——reversal 429
——Number Sixteen 428
——title 429
——universal negative 429
——universal positive 429
DeVry
——camera 23-33-*35*-67-74-200-202
——projector *65*-*230*-*249*-*250*-262-*263*
——screen *243*
Diaphragm stops 40
Direct focus 146
Direct titles 167
Dimensions of subject 379
Directing
——closeups 398
——completed action 389
——crossing lead 391
——dramatic suspense 390
——entrances and exits 386
——illusion of coincidence 391
——inserts 398
——laws of 384
——length of scene 397
——looking at camera 395
——off screen action 386
——off screen vision 390

Directing (*Cont.*):
——position for 383
——"punch" 392
——rules of 383
——tempo 392
——unfinished action 393
Direction
——of film travel 190
——of motion 308
Disc films 18
Distance meters 60-*65*-146-61
Distance of subject 419
Dissolves 208
——lap 210
——round closing 210
Distortion, linear 131
Double exposure 135
——without masks 202
——with masks 206
Double toning 299
Drama 352
Dramatic production 349
——suspense 368
——technique 354
Drem meters *45-48*
Dremette *11*-186
Duplicate films 282
Dusenbery, Syril 42-169

E

Eastman 16-20
Edison, Thos. 16
Editing 213-*220*
——illusion in 215
——library 215
——purpose of 213
——rack *220*
——sequence 216
——tempo 216
Effect set 37-*65*-*110*-*147*-155-*156*-*173*-201
Elements of trick work 191
Emulsions 270-282
Enlarging from M. P. film 11
Entrance 386
Evil eye 321
Exits 386
Exploration 333
Exposure 39-285
——at abnormal speed 425
——and development 420
——factors 40
——interior 108
——making the 334
——slow motion 78
——sympathetic 90
——title 170
Exposure meters 40-90
——calculator 40
——Cinophot *45*-108
——Drem *45-48*
——extinction 44
——Filmo *43*
——Harvey 41
——Milner 42
——Rexo 42
——Watkins *43*
Exterior
——lighting 80-*81*
——subjects 314
Extinction meters 44

F

Facial expression 385
Fade 209
——printer 292
Family films 357
Fencing 326
Field of lens 55-134-143-334
Film
——age of 282
——amber 252-283
——area exposed 190
——blue 252
——brilliancy of 282
——care of 239
——cement 228
——classification 313
——cleaning 255
——clips 255-289
——developing 284
——disc 18
——duplicate 282
——editing 213
——family 357
——footage 370
——green 252
——home developing of 285
——inspection *251*-255
——labelling 235
——latitude 282
——library 215
——light amber 252-283
——master 283
——non-ribbon 17
——panchromatic 150-283-341
——paper 19
——physical form 270
——pink 252
——polishing 233
——red 252
——sensitivity 40
——speed of travel 190-200
——storing 233
——tinted 251

Film (*Cont.*):
——tinting and toning 293
——travel direction 190
——vacation 372
——yellow 252
Filmplates 187
Filmslides 401-*404*
——camera for 403
——Leica 403
——projector 403
Filmo
——camera 23-29-*30*-67-74-200-202-*172-195*
——color filter 252-*294*
——exposure meter *43*
——focussing microscope 64-*66*
——panorama head 68
——projector 260-*261*
——title writer *172-195*
Filters 90-149
——factors 408
——graduated *151*
——projection 251
——red 283
——use of *153*-408
Fishing 326-332
Fixation 272-429
Flares 90-337
Flashback 219
Focal length of lens 55-134-143-334
Focus
——conjugate 58-416
——depth of 60
——direct 146
Focussing 55
——microscope 64-*65-156*-205
——projector 240
——visual 62
Fodis range finder 60-*61*
Fog 287
Football 326
"Foot and frame" count 204
Formulae
——development 428
——projection 408
——toning 297-430
Furniture 351

G

Gelatin 286
Glossary 432
Goerz
——C. P. 148
——effects (See reflecting focussing device; mask box; focussing microscope; sliding base) 37-64-*65-110-147*-155-*156-173*-174-201-208
Goerz (*Cont.*):
——lenses 157
——Tenax distance meter 157
Golf 326
Gold screen 241
Goodwin, Rev. H. 16
Griswold film splicer 225

H

Halogens 270
Hand lettered titles 167
Hands in acting 385
Harvey exposure meter 41
Historical costume 348
History of cinematography 15
Home development 285
Home films 314-357
Humidor, film 233
Hunting 326-331
Hydroquinone 286
Hyperfocal distance *56*-414

I

Illumination 94
Illusion
——of motion 14
——in edition 215
Image
——formation *130*-132
——photographic 271
Incandescent light 96
Inches to millimeters 422
Insect photography 201-291-342
Inserts 218-398
Instructional films *327*-328
Intensification 429
Intensity of light 40-97-271
Interior
——exposure 108
——lighting 94-380-*110*
——subjects *110*-314
Intermittent action 237
Iris
——in 210-217
——out 210-217
——outside 37-*65*-154-210-211
Iron toning 297

J

Jenkins, C. Francis 2
Joining film 230

K

Kodak
——Ciné 23-26-*27-29*-67-74-*128-312-331*

Kodak (*Cont.*):
——rewind *65*-223
——splicer 223
Kodascope "A" *256*
——model "B" *258*
——model "C" *257*

L

Laboratory work 285
Landscape work 324-401
Lap dissolve 208
Latitude of film 282
Laws of direction 384
Leica camera *65-402*
Lens 128
——aberrations 131
——anastigmat 132
——angle 135
——brilliancy 138
——circle of confusion 56
——classification 137
——conjugate foci 58-415
——Cooke 158
——Dallmeyer 158
——depth of focus 140-413
——diaphragm 40
——extension 38-201-342
——field of 339-342-410-411
——fixed focus 59
——focal length of 55-*135*-*143*-334
——Goerz *65*-*147*-157
——hyperfocal distance 56-114
——image formation *130-132*
——long focus 145
——Meyer 140-159
——normal 142
——rapid 142
——rapid rectilinear 131
——residual aberration 139
——Schneider 159
——speed of 97-*133*
——telephoto *144*-*147*-321
——ultrarapid 93-138-*141*-320
——universal focus 55
——Wollensak 157
——Xenon 141
——Zeiss 158
Library films 215
Light *129*
——actinic power 40
——action of 39-86
——arc 96-112-114-118-127
——back 106-*107*
——balancing 85
——chemical effect of 270
——color of 81
Light (*Cont.*):
——direction of fall 80-84-101-*102*-*129*
——effect upon haloids 271
——front *100*-106
——hazy 83-89
——high *105*-106
——incandescent 96
——intensity of 40-97-271
——low 104-*105*
——manipulation of 99
——path of 80-129
——plain *100*-106
——poor 89-323
——primary 103
——pure 84
——quality of 82
——reflection of 80-87
——side 103-*104*
——source of 94
——spot 109
——synthesis of 99
——trickery 89
——ultra violet 34
Light, arc
——amperage 98-117
——Cameralite *110*-116-127
——Da-Lite 125
——double range 121
——Gelb 122
——Halldorson 123
——intensity of 98-112
——Little Sunny *110*-119-127
——Minima *118*-127
——Perkins 125
——pocket *118*-127
——to extinguish 127
——Wohl Duplex 123
——Wohlite 123
——versus daylight 113
Lighting
——accent 109
——artificial 94
——balanced 85
——emotional effect of 109
——equipment 94-116-125-351
——exterior 80
——flat 82
——for sport work 334
——harsh 82
——interior 94-380
——sympathetic 83-212
——the set 378
——time—space—intensity 97
——trick 89
Linear distortion 131
Linear perspective 379
Location 373
Long focus lenses 145

M

Machine splicing 224
Magnesium flares 40-337
Makeup 376
——amateur 377
——character 378
——colors 378
——crepe hair 378
——reason for 376
——straight 377
Manipulation 315
Marine work 341
Mask
——box 37-64-*65*-*110*-*147*-155-*156*-*173*-174-201-208
——double exposure 155-*206*
——effect *147*-155
Material for costume 376
Meters
——exposure 40-90
——distance 60-146
Metol 286
Metric system 422
Metric to avoirdupois 424
Microphot 344
Microscopic work 344
Millimeters to inches 423
Milner light gauge 42
Miniature still cameras 401
Miniature subjects 201
Miraculous effects 191
Mirror 88-212
——parabolic 238
——projector 238
——to clean 238
Modelling 103-379
Monotone filter *65*-86
Motion
——dictionary of 308
——direction of 308
Motion picture
——cameras 22
——first 16
M. P. P. & D. 303
Multiple exposure 203
Muybridge, Edward 16

N

N. G. 68
Natural history 335
Nature study 335-336-337
Negative 268-280
——developer 428
——positive process 272
Night effects 91
Nocturnal animals 335
Non-ribbon films 17

O

Off screen action 386
Off screen vision 390
Optical accessories 211

P

Pam 68
Panchromatic film 150-281-341
Panorama 68
——rapid 68
——scenic 323
Paper films 19
Particles, playing the 273
Patching (see splicing)
Pathescope 20
Pathex
——camera 22
——projector 264
——superreel 266
Pathexgraph 171
Period costume 348
Permission to photograph 320
Persistence of vision 14
Personal films 357
Perspective
——atmospheric 379
——illusion of 379
——linear 379
Photo Era 3
Photographic image 271
Photoplays, amateur 348
Planned shots 314
Plot development 368
Point of view 384
Polishing film 233
Polo 326
Positive
——developer 428
——negative process 280
——processes 268
Preservative 286
Printing 268-272-280-290
——double 292
——fades 292
——tests 291
——trick 291
Prism 129-212-322
Projection 235
——broken connection 245
——broken film 245
——burned out lamp 245
——changing focus 247
——faults 245
——focal length of lens 244
——formulae 408
——lens 239
——lighting room 253

Projection (*Cont.*):
——loss of loop 247
——motor fails 246
——music with 253
——"rain" 246
——shutter stop 245
——screen sizes 245
——torn perforations 246
——travel ghost 240-246
——with color screens 251
Projector
——clean lenses 247
——condensor 238
——DeVry *65-220-249-250*-262-*263*
——Filmo 260-*261*
——filmslide 402
——focussing 240
——framing 239
——intermittent 237
——Kodascope *256-257-258*
——lacing 239-248
——lamp 238
——Leica 403
——lens 239
——light source 237
——mechanism of 237
——mirror 238
——Pathex *264*
——shutter 240
——Superreel *266*
——threading 239-248
——Victor 260
Production 311

R

Racing 76
Rack
——cutting 230
——developing 289
——Stinemann *288*-289
Range finder 37-60-334
Rapid rectilinear lens 131
Record films 314-316-326
Red toning 297
Reduction
——chemical 271
——physical 429
Reels, film 248
——self threading 248
Reflection 80-87
Reflectors 80-87-374
——Westphalen 87-108-*110*
Reflecting focussing device 30-38-62-*65-110-147*-148-*156-173*-184-201-205-211-291-343
Rehearsal 382
Rembrandt lighting 106
Remote control for camera 338
Residual aberration 139
Restrainer 287
Reversal process 268-272-274
——bleaching 276
——over exposure 279
——Pathe 430
——solutions 428
Rewinds *221*-255
Rexo meter 42
Round closing dissolve 210

S

Scenario 161-356-361-364
——climax 369
——construction 367-370
——detail 369
——development 359
——suspense in 368
Scene length of 397
Scene record *372*
Scenic subjects 323
Scientific subjects 335-*345-346*
Schneider lenses 159
Screen 235-240
——ACH 243
——aluminum 241
——automatic 243
——bead 242
——brilliancy 296
——color of 236-241
——DeVry *240*-243
——gold 241
——image brilliancy 241
——portable 243
——protection 243
——Prisma 65
——silver *236*-241
——size 241-416
——support 243
——white 242
Sensitivity of film 40
Sepia toning 297
Sequence 216-367
Sets 375
17.5 millimeter film 19
Shadows 89
——luminous 103
Shooting 326
Shutter
——angle 23
——projector 240
Silver
——bromide 270
——grain 271-273
——screen 241
Sliding base 62-64-*65-110-147*-*156-173*-174-205-211

Slow motion 31-73-75-199
——analytic 328
——critical 328
——exposure 78
——instructional 328
——lens speed 73
——nature study 340
——sports 328
Snakes 340
Snapshooting 312
Spectres 203
Spectrum 149
Speed
——abnormal 74
——camera 71
——rapid 73
——slow 72-75
Spherical aberration 131
Spirograph *18*
Splicer, film *222*-*223*-*225*-*227*
Splicing film 224
——hand 229
Sports 77-*317*-326-*329*
Steeplechase 332
"Stills" 402-405
Stinemann *269*-287-*288*-*290*-294
Stop camera 191
Stop motion 194
Studio, amateur 350
Submarine subjects 341
Substandard sizes 426
Sulphide toning 297
Surgery 346
Suspense 368-390
Sympathetic lighting 83-112
Synthesis of light 99

T

Table-top cinematography 197
Tanks, developing *220*-288
Telephoto lenses 144-321
Tempo 216-217-392
Tennis 320
Tests, printing 291
Thermometric tables 424
Threading projector 239-248
Time condensation 198-343
Time—space—intensity 97
Tinting 251-293-296
Titles *166*
——animated 175
——backgrounds 165-169
——border 168
——classification 160
——composition of 163
——cutout 168
——cutting in 219-231
——decoration *161*-165-168

Titles (*Cont.*):
——developer for 428
——direct *164*-167
——equipment for writing 167
——exposure for 170
——field 155-171-174
——film plate 187
——finis 189
——for scenic films 185
——footage 163
——Goerz *173*-174
——gummed letter 167
——hand lettered 167
——Kodak 170
——lighting 170
——made-to-order 170
——motif 162-168
——photography of 170
——relative aperture 174
——spoken 219-232
——styles of letter 165
——tapestry 169
——use of 160
——wall paper 169
——writer, Filmo 172
Tonal quality 101-281
Toning 293-297
——double 299
——formulae 298-431
——iron 297
——red 297
——sepia 298
——suitable 299
——sulphide 297
——uranium 297
Trick work 190
——animation 195
——cartoons 195
——doll work 197
——double exposure 202
——without masks 203
——double printing 291
——elements of 191
——miraculous effects 191
——reverse 192
——slow motion 199
——spectres 203
——stop camera 191
——stop motion 194
——thrillers 193
——titles 175
——time condensation 198
——use of 190
Tripod 36-52-69
——ACH 70
——folding 70
——heads 52
——home portrait stand 69
——in nature work 337

Tripod (*Cont.*):
——metal 70
——Omnia 70
——tilt 54
——Triax *37*-*53*-70
——Truball 70
——walking stick 70
Tropical work 324
28 m/m film 19
Two film process 268-272

U

Ultra-rapid lenses 93-138-320
Ultra violet light 34
Unity 111
Universal focus 55
Uranium toning 297-299

V

Vacation subjects 373
Victor 2-20-67
——camera 23-31-*32*-*65*-67-74-*110*-*147*-*156*-*173*-200-202
——projector 260
Vision
——off screen 390
——persistence of 14
Visualization 356

W

Walk 388-394
Watkins meter 43
Westphalen 87-108-374
Wheel of life 15
Winton, Roy W. 3-12
Wollensak lenses 157

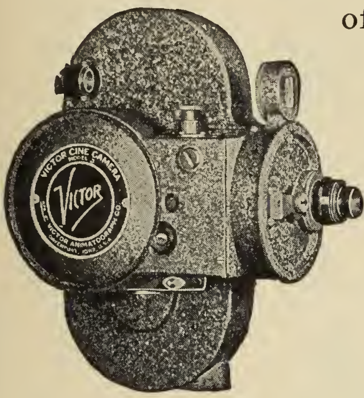
Z

Zeiss lenses 158

Experts and Beginners

ACCLAIM the Accomplishments

of the



Victor Ciné-Camera

QUICK adjustment of speeds, half-normal, normal and high speed for SLOW-motion; absolute steadiness and sharpness of pictures at all speeds; convenient location and accuracy of the view-finder; smooth "velvety" action of the control button; full start and dead stop without jar; simplicity of threading film; quiet vibrationless mechanism; silent light-running crank wind; hand crank feature; perfect SLOW-MOTION—all are features emphasized in the enthusiastic comments of users.

The Victor Ciné-Camera marks the beginning of a new era in amateur motion-picture photography.

Price $125 Complete

With F/3.5 Velostigmat lens

(Uses Ciné-Kodak and other 16m/m Daylight loading film)

Ask your dealer or write direct for further information

VICTOR ANIMATOGRAPH CO., Inc.

DAVENPORT, IOWA, U. S. A.

3 00